THE NEW MOTORING

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CHAPTER I

DIFFERENCE OF OPINION

In 1914 the motorist had a big range of cars to choose from, but the much-discussed £100 car had not materialised, and there seemed no particular likelihood of its doing so. Indeed the tendency was for the price of cars to increase, for one important section of the public was in a mood to demand greater detailed convenience and luxury, while maintaining a constant feud with the manufacturers, who were in the difficult position of having to give, in each year's new chassis, greater value for less money.

On the other hand, another section of the public demanded cheap and ultra-cheap cars regardless of all other considerations. Naturally the maker elected to take advantage of the market ready to his hand. In consequence great sections of the public, and the bulk of the manufacturers, seemed unable, as the Americans say, "to get together."

Generally speaking the average motorist wanted a good car at a low cost, but the lowness was to continue in the running as well as

in the first cost. At the other end of the scale there was a desire in certain manufacturing quarters to pander to the supposed exclusiveness of motoring, regardless of the common truth that while there is a market for the best it is impossible for a dozen or more different things to be best at the same time.

Perhaps the whole secret of the matter was that the motor industry, as things now go, was a comparative youngster, hardly out of its experimental swaddling clothes. Fortunately though at one time it seemed an extremely unlikely occurrence, the war has changed all our old-fashioned and unprogressive views.

Nowadays the motorist does not regard the motor-car as a mysterious mechanical construction which none but experts can understand. He has grasped its broad constructional principles well enough, and he has quite a good idea as to the type of vehicle suited to his particular needs, together with more than a shrewd idea as to the price which it can and should be sold at.

Only a very few years ago things were widely different. It was not so much the case of a maker advising buyers wrongly, but rather a case of the maker himself not being perfectly clear in the matter. Some designers maintained that the single-cylindered car was ideal for the smaller vehicles; others thought that two cylinders were better; one or two firms built

three-cylindered cars; others again came to the building of four-cylindered engines.

The controversies that ranged in regard to engines were repeated and multiplied in the case of clutches, gear-boxes, axles, steering, and, indeed, of practically every component throughout the chassis. It was, as already said, a fumbling period of experiment and research, in which theory had to be translated into practice before it could be judged either failure or success.

Nowadays the motorist knows what he wants, and makers are inclined to agree with him on general principles, the latter's greatest problem being simply one of ways and means. Actually the average manufacturer cares very little as to the nature of the finished product turned out from his factory, so that it be an honest article giving good sound value for the money.

Logically there can be no sentiment in commercialism, and if this be so the car builder must be guided by common-sense business principles. He can choose between building 500 cars in a year and making £100 profit on each, or an annual profit of £50,000; or he can build 10,000 cars of a more popular type and be content with a £10 profit on each, which would show twice the return on the year's working.

The market for the cheaper car is, of course, very much greater than that for the more

expensive, although it has only been in late years that the truism has been generally acknowledged.

Some firms are very much better off now than they were before the war, while others are, all things considered, not nearly in such fortunate circumstances. It is not altogether a matter of capital and manufacturing plant. In these respects the majority of the car-manufacturing firms are better off than ever, while even newcomers to the industry are starting with a sufficiency of modern machine-tool plant and adequate financial reserves. This makes rather a striking difference from the early days of some of the most successful manufacturers who began operations in somebody's backyard with a staff consisting of one small boy.

It is the dislocation of the sales departments and the designing staffs, coupled with the break-up of manufacturing routine and the interruption of the old sources of supply, that is proving so serious a handicap to the post-war prospects of a great many concerns. However, the public is not particularly interested in this aspect of the matter, the top and bottom of the matter being that the motor industry must reconstruct itself to the best of its ability.

Some of the more go-ahead makers have definitely made up their minds about their

future manufacturing programmes. These, at least, have the courage of their convictions, and reward or punishment will follow in due course, according to the accuracy or otherwise of the individual judgments. Other firms are waiting for a definite lead on the part of the public before committing themselves, being content in the meantime to work up held-over stocks.

Even the 1919 public, however, is not entirely satisfied that the £100 car is beyond the bounds of possibility. The nearest thing we ever got to this famous vehicle was the two-seater Ford, which sold in this country at about £115 before the war. Even this figure is a considerable advance on the U.S.A. price of the vehicle, which was approximately £72.

The public must make allowances for the widely different conditions in the two countries —conditions that must, in almost every case, react in favour of the American maker. Before the war the latter had factories which were manufacturing on the gigantic scale, and there was a ready market to hand for hundreds of thousands of vehicles, without freight and taxation problems entering into the matter at all.

These big factories, once a car has found some degree of public favour, worked almost to mathematical exactitude. On the capital invested, for example, it would be calculated that on the year's working an output of 52,000

cars would be necessary in order to justify the building of the car. It will be readily obvious that if, by clever organisation during the year, the estimated output could be achieved by the middle of November, for example, there would be a sufficient margin in hand to do great things with. Actually the American manufacturers, small blame to them, allow precious few opportunities to slip through their fingers.

But in England, before the war, it was, quite frankly, a very doubtful possibility whether any factory with an annual output of 50,000 to 100,000 cars could have been a success. Quite obviously it would not have been alone in its glory. Rivals would have sprung up, the Home market would have been supplied in the course of a few years, and when trading in protected Overseas markets, at a time when Imperial and Colonial preference was frowned on, the British maker would have been at a disadvantage compared with his American rival, simply because the bulk of his output would have had to be sold Overseas, while the bulk of the American output could be disposed of in the U.S.A. market at a profit sufficient, in case of fierce competition arising, to allow of the prices of those machines sold in competition with those of the British cars, being cut out of all proportion.

Of course, the British factories are now taking a broader view of things. They are

fitted with better plant, have greater financial resources, and there are individual makers who are contemplating outputs infinitely greater than was ever dreamed of in 1914.

In addition, we intend to produce in future many thousands of assembled cars. Although at the time of writing it is premature to be very definite about amalgamation schemes, it will be found that the British output in the future will not suffer under arrangements which call for individual factories to specialise in different car components to the end of producing standardised vehicles in big numbers.

In the U.S.A., Mr. Henry Ford and his son might eventually succeed in building a car to sell at approximately £50. At the best, £50 in the U.S.A. means at least £80 here, because it is extremely improbable that the English market will ever again be open, and tax must be paid on the cost of the vehicle in the country's origin plus insurance and freight. It is doubtful whether, even with assembling factories in Great Britain, the price of the present type Ford will ever come down to the old pre-war figure.

In this way one prepares the public for the horrid truth that there is no reasonable prospect of an immediate reduction in the cost of motor-cars. Logically, like almost every other commodity, prices ought to be very much higher, owing to the greater cost of raw materials

and labour. But there is some hope that, by skilful factory organisation, by using better materials, by building in bigger quantities, and with the aid of the ultra-modern machine-tool plant now in the country, prices will be maintained at a reasonable level.

For every increase in the price of a car the number of its potential buyers decreases. Makers are very well aware of the fact that, though there may be 10,000 people able to buy a £1,000 car, there will only be a thousand in a position to buy a £10,000 vehicle. Because of this the general manufacturing tendency will be to keep prices as low as possible. Owing chiefly to this fact the motoring public may rest content—so far as human limitations allow—in the knowledge that there will be no profiteering in motor vehicles, at least on the side of the manufacturers, so soon as normal production is resumed. This, indeed, is not philanthropy, but simply sound commercial sense.

At the best it will be well into 1920 before the average price of cars settles down to anything between 20 and 30 per cent. more than the 1914 figures. Whether they will ever reach the pre-war level remains to be seen. Many well-informed people think that eventually they will. In the writer's opinion there must be revolutionary changes in manufacturing methods, in design, and in the public taste, as a preliminary.

CHAPTER II

ABOUT THE CHEAPEST MOTOR-CAR OF ALL—THE CYCLE-CAR

The would-be motorist of strictly limited means is very little nearer to a solution of his difficulties now than he was ten years ago. In those long-ago days he could find at the motor exhibitions small cars built to suit his moderate purse, but few of these low-priced machines ever gave good service in the hands of users. One or two makes were excellent, but the bulk of the machines were poor. They were badly designed and unsuitably built. Repair bills were unreasonably high, while no very successful attempt was made by any manufacturer to produce on an adequate scale. In passing it may be remarked that only in quantity-production lies the hope of a really sound low-cost car.

Nowadays the economically inclined owner has a choice of three classes of vehicle. He may, supposing his spending power be limited to, say, £200, buy what has come to be called a cycle-car, of which a good specimen may be

had for less money, and a really high-class machine—so far as the type goes—for the full amount; he may go in for a low-priced light car proper; or he can buy one or other of the lighter American vehicles. At the time of writing, early in 1919, prices are unduly inflated owing to the remission of the petrol restrictions and the excess of car demand over supply. By the end of the year, however, and almost by the time this comes to the reader's hands, one may anticipate that prices will be more normal.

After-war taxation will have a big influence on the prices of foreign-built machines. The whole question of motor taxation needs reconsideration. We do not want either a closed nor an open market. A tax of 33⅓ per cent., with possibly a small Colonial and Allied preference, might meet the case.

The cycle-car has its points. In fact, it is mostly points! It has been defined as having all the appearance of a bassinette with none of its comforts; and another humorist said that cycle-car owners lay on their backs and waved a steering wheel in the air. The truth is, however, that the cycle-car has decided possibilities, but its friends would have been better advised not to have forced its growth, for continual harping on the theme that a huge market awaited the successful very light car led to the building of numbers of unsuit-

able machines, with the inevitable consequence that even the good products incurred some of the odium attaching to the failures.

It seems to be immaterial to the cycle-car enthusiasts whether their machines have three or four wheels. Very largely it is a matter of personal preference. We have not yet seen either the one nor the other that could truthfully be called satisfactory from an engineer's point of view. On the other hand, some vehicles, though in many respects outraging conventional design, give very good results in service. In fact, the time has come when it may be said that the cycle-car affords the most economical motoring of any, excepting, of course, the motor-cycle. This could not safely be said whilst the cycle-car was in its earlier experimental stages.

The three-wheeled cycle-car is a fairly simple mechanical structure and, if of sturdy build, will give years of excellent work. In its simplest form it has a single-cylindered, air-cooled engine, driving through a simple form of gearing direct to the single rear wheel. The general construction puts two wheels in front, through which steering is effected, and the driving wheel amidships at the back. It is the usual practice to provide a two-seated, side-by-side body located well forward, and a reasonable amount of space for luggage is also given.

Taking all the strain of the drive, however,

there is some difficulty in housing the single rear wheel in sturdy enough manner, while leaving it accessible. If it get out of alignment undue wear and tear of tire and driving chain follows. Beyond this trouble, which can be obviated with a little care, and if one can be satisfied with the appearance and accommodation of the machine, the type is quite good. Its first and upkeep costs are low, and it is a simple construction not easily put out of order, while it can be maintained with the minimum of effort.

An advance on this simple three-wheeled practice is found in those machines having a two-cylindered, V-type water-cooled engine set to the front of the chassis. Water-cooling is not essential, and successful air-cooled units are to be had, but the water-cooled system was, on the whole, preferable before the war. During the last four years, however, it is possible, and even probable, that the experience designers have had with air-cooled aero engines will lead to considerable improvements being made in the type.

The water-cooled engine is rather more complicated, costs a little extra, and, of course, adds to weight. Against this, at least in the machines following pre-war practice, must be *set some advantage in greater consistency*

Yet there is little in it. As single- and two-seated machines the type has attained quite a degree of favour, especially amongst the younger set of motorists.

Representative specimens of all the three-wheeled cycle-cars should be had when things settle down, for £100–£125. The first of the pre-war machines, however, were selling at roundabout £150. The average driver should get anything between 45 and 60 miles to the gallon of fuel, and a speed of between 40 and 55 miles per hour.

Tires wear well, especially if extra-sized covers be fitted and the air pressure well maintained; 4,000 to 5,000 on the driven wheels, and up to 7,000 and 8,000 miles on the others can be obtained with ordinary common-sense driving. The Treasury tax is low, but as already said the whole matter of motor taxation is to be reconsidered, and it is always possible that the tax on the machines themselves may be increased. It would be unfair and unfortunate, but one never knows!

A more ambitious attempt than either of the machines referred to, is the four-wheeled cycle-car. Here the engine power is kept low, 10 h.p. being the average, and either water- or air-cooling utilised, the latter being most common on the lower-priced machines. Economy in both manufacture and mainte-

nance is sometimes obtained by dispensing with the usual tpe of geared transmission and taking the engine power direct to the rear wheels by long belts or chains. Here we have another engineering convention apparently outraged. By all the laws and rulings the belts should prove unsatisfactory, but in practice they are nothing of the sort.

The simplest form of four-wheeled cycle-car transmission interposes some form of clutch or friction disc between engine and driven pulleys, the gear ratios being obtained by fitting a variable belt drive. Such an arrangement dispenses with driving shafts, gear-box, and complicated back-axle with its gears and differential.

Other designers prefer to fit a simple gear-box and fixed pulleys, and there are numbers of other combinations and simplified transmissions available to the ingenious designer. The differential gearing is being dispensed with on more than one machine, for example. From the point of simplicity, both in construction and operation, there is a lot to be said for these cycle-cars. No really satisfactory machine of the kind made its appearance before the war, but the latest lists show that numbers of new makers have entered the field, and although it is too soon to speak from practical experience, it must be admitted that some of the published specifications are very promising.

The first cost of such machines may be slightly higher than that of the three-wheelers. The engine and transmission can hardly be more simple, and there is an additional tire to be allowed for; against this, weight, and therefore wear and tear, is more evenly distributed. Further, better accommodation for passengers and luggage can be provided. In actual running costs there is little to choose between the types three or four-wheeler. The engine powers are, of course, low, but the total weight of the machines is in proportion. There is no fear that any of the vehicles will fail to do any reasonable work that may be imposed on them in this country, and they have quite a fair turn of speed. In traffic their handiness is a great point in their favour.

For solo work, where accommodation and means are limited, and for feminine drivers not physically strong enough to wrestle with a bigger car, either the three or the four-wheeled cycle-car offers a satisfactory motoring solution.

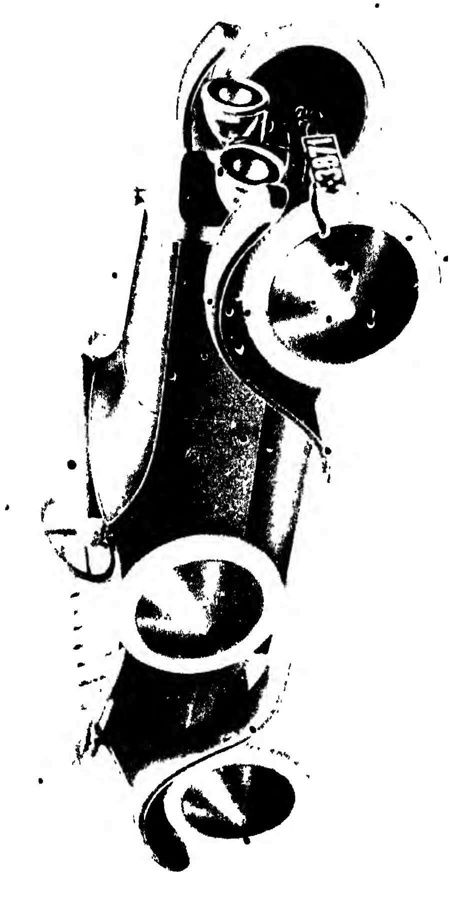
So far as this country is concerned, with its peculiar manufacturing and other problems, this simple type of cycle-car offers the only feasible chance of the Ugo car itself. No machine yet on the market, however, is as good as it might be made. In addition to strengthening the chassis and making the whole more trustworthy mechanically, the successful de-

signer will have to remove all suggestion of freak and toy appearance from his car.

On the 1919 market there are about twenty different makes of cycle-car, all of which sell for under £200. In addition there are almost as many more builders engaged in the preliminaries of building a cycle-car. On the whole the public had better stick to those machines that have already had some experience on the road in the hands of private users, for even a complete car at £100 can be a costly affair if repairs are everlastingly needed, and the machine fails in its road performance.

I find that £105 was the cheapest new cycle-car in May of 1919. This machine has an 8 h.p. 2-cylindered air-cooled engine, and it is a mono-car, or, in other words, has seating accommodation for the driver only. It has a kick-starter, three forward speeds, while the transmission is by chain and belt. Against this the most popular three-wheeler is a machine selling at £115, or with various refinements at £150–£160. This has an 8 h.p. 2-cylindered water-cooled engine, and seats two people. There is a shaft and chain transmission, which gives two forward speeds. The machine is very fast and reliable.

If users lose sight of the main feature of the cycle-car, which is low cost, and demand all sorts of luxuries, such as electric-lighting, engine-starters, patent wheels, many special



fittings, costly upholstering and coachwork, they will find that prices must inevitably go up. The cycle-car can be an excellent sporting or business machine, but frankly it cannot try to compete in luxury and finish with the big cars.

CHAPTER III

HOW THE SUCCESSFUL LIGHT CAR PROPER CAME INTO BEING, AFTER MANY FAILURES

NOWADAYS the light car seems a perfectly logical creation, yet it has had a chequered career, and it was not until the outbreak of war that hardly won popularity was within reach. Looking backwards it is easy to see where mistakes were made: without experience designers blundered badly. Actually what happened was that the early car builders, dealing with materials rather out of their ken, had no desire to cut safety margins too close, and in consequence did their best to insure against breakage and accident by building their chassis along very massive lines.

Because of this the motorist was forced to drive round with anything between 5 and 20 cwts. according to the size of car he owned of unnecessary material; and although tires were fairly costly, petrol and oils were comparatively cheap, so nobody grumbled very much—nobody, that is, except that curious personage describing himself as "a man of moderate means."

As matters changed, as running expenses continually increased while mechanical trustworthiness improved, and motorists began to be less afraid of their cars, a demand grew for different types of machines. Owners who, for some reason or other, did most of their driving alone, began to ask why they should have to buy a four-seated car.

"You haven't," answered the builders. "We'll get the coachbuilders to put a two-seated body on for you."

For a while the owner was satisfied with the concession, until he began to find that his running costs were reduced by very little if by anything at all. Further queries followed. Makers agreed that the car to carry two people only need not be so strong as those designed to carry four passengers and luggage. Accordingly they began to pare away material here and there wherever they thought it could safely be spared. Rather less powerful engines were installed, a two seated body was fitted.

"And there," said the manufacturer, "you have a splendid light car!"

He was wrong in both theory and in practice, yet it was years before the fact was generally admitted. At last designers woke up to the fact that, beyond using a petrol engine, together with gears and axles, the light car had little in common with its bigger brother. From the engineering point of view it was a

different problem altogether. Successful light cars could not be made just by cutting down the heavier machines. They demanded special design from beginning to end, just as the bigger cars themselves had done in the first place: and when British car manufacturers acknowledged this simple fact the satisfactory light car came appreciably nearer. Above all other vehicles the light car is a British construction. Other designers may follow, but the Britisher led the way.

The light car is not to be confused with the cycle-car. As a matter of fact there are more or less satisfactory official definitions which the average motorist never has and never will trouble his head about. All he wants to know is what sort of machine he can buy for the sum at his disposal, what it will cost to run, what power it has, and what speed it will attain? Answer these questions and the average man cares very little whether his car is in the light car, the locomotive, or the traction engine class!

So, broadly, the light car may be defined as a two-seated machine, sometimes with a third seat added in the form of a dickey seat. Strictly speaking, the light car may have a four-seated body, but this type of vehicle is important enough to demand separate treatment, which is accorded it in the following chapter. In the latest of the post-war light

cars there is a nicely upholstered seat, snugly fitted in between the main seats, making a sort of trefoil pattern, with all three seats protected from the weather. The car has a small engine, generally water-cooled, with either two or four cylinders, driving through an orthodox simple type of clutch to a small gear-box, and thence, by shaft, to the back-axle, which may be worm or bevel driven as the maker prefers. Actually, there are one or two noteworthy exceptions to this general design.

Broadly, also, price may define the light car. If it be a two-seated machine, with an engine of roundabout 10 h.p., and selling at somewhere between £250 and £350, it may, for all purposes, be admitted into the light car proper class. These prices are too high, of course; sooner or later they must be reduced; but labour costs, raw material prices, the general dislocation of the factories, and a score of other factors all tend towards forcing up the prices of cars in 1919.

Curiously enough one light car which differed materially from what had come to be practically standard practice, proved one of the biggest successes prior to the war, and there is every likelihood that the post-war cars by the same maker, improved in detail but unchanged in broad principle, will achieve even greater popularity. There are designers and theorists, both professional and lay, prepared to prove

that by all the laws of mechanics and mathematics the car in question should prove impracticable: they will point out that the ideas incorporated in the construction have been tried and found wanting in a score of other instances: but despite all this the cars in question are standing up excellently in service. Experienced drivers get all they need in speed, power, and economy, while the veriest novice finds the machine pre-eminently trustworthy on the road.

A two-cylindered water-cooled engine was employed—in the latest chassis a four-cylindered engine is being used—housed well to the rear of the chassis, the usual type of clutch was dispensed with, and the drive was through friction discs, and thence by shaft to the bevel-geared back-axle. This construction did away with the ordinary type of gear-box: when the friction discs were not in engagement the engine ran free: gear changes were made by moving the driven disc across the surface of the disc, which also served as the fly-wheel, keyed directly to the engine, reversing being obtained by crossing the driven disc across the centre of the engine disc. The extreme simplicity of the arrangement made the car very sweet to handle, and by sturdy construction and the use of the soundest materials the errors of earlier builders who had tried a friction drive, and found it not satisfactory, were success-

fully avoided. The improved cars of this make, which are changed slightly in detail and transmission lay-out, but which are substantially the same cars that gained so remarkable a popularity before the war, will prove the most formidable rivals to the more usual type of vehicle. They are now supplied with a four-seated body, and can confidently be recommended but, alas, the price has gone up to £275!

A somewhat detailed specification of one of the most popular of all the more orthodox light cars will be of interest, and may serve as a general guide as to what may be generally expected. As to slight differences in design and construction, in the matter of body finish and accommodation, these are matters best left to the individual preference of the buyer, but a word of warning will not be misplaced. Firstly, a light car is just that a light car. It is not designed as a racing machine, nor as a juvenile commercial truck. Too heavy and cumbrous a body imposes an unfair handicap on the mechanism, and though the coachbuilder be wise in his generation, the car owner can come to disaster in the matter of undue fuel cost, mechanical fracture, and ruinous tire bills if he habitually overloads the machine. He may overload by carrying unnecessary weight, either in the shape of commercial goods or by decorating running boards and dickey seats

with friends and relations—the two not necessarily being synonymous in every case.

The car referred to used to sell, very completely equipped and ready for the road in every respect, at £235. Now it may be somewhere between £350–£375, the price not being definitely settled. There is a four-cylindered engine of 10 h.p. R.A.C. rating. Beyond seeing that the lubricating oil is maintained at the proper level the owner has no cause to tinker with the engine for some thousands of miles of running. A British-built magneto provides for the ignition, and an electric-lighting set is also installed.

The power is taken through a disc clutch to a three-speed gear-box, and thence by shaft to a worm-driven back-axle. For the purpose, and with intelligent use, the braking system is ample to deal with every conceivable situation. Handsome steel wheels are fitted, together with a spare wheel and tire. The body has a wide seat for two people, capable of seating three at a pinch, and the space to the rear is used for the provision of ample locker accommodation; a dickey-seat can be fitted at the buyer's option. Broad running boards and big domed wings give the car a distinguished appearance, which is accentuated by the buff-coloured finish of the coachwork, the jet black of the wings and side shields, and the dark blue of the upholstery.

Taking the matter by and large, this type of machine as a light two-seater can hardly be bettered. In detail one would desire a hood and screen giving fuller protection in bad weather, yet this is more in the province of the accessory manufacturer. Even the car builder, however, should remember that users may take an objection to an excellent chassis simply because of a leaking hood. At the price now being charged for light cars there is no reason why the driver and passenger should not be given the same luxury, on a smaller scale, of course, as that provided on the bigger cars.

In light car buying, particularly, the name and reputation of the maker should be considered. The problem of light car construction is a fascinating one, and it has attracted many, for the reward to a successful designer and maker is stupendous. Some very excellent machines have, and will be, built by concerns quite new to motor manufacturing, but one cannot advise the ordinary buyer as distinct from the skilled and experienced motorist capable of forming an independent judgment to indulge in new cars that are, in the very nature of things, in the experimental stages. A clever design, backed by sound work in the shops, soon gets to the front and is favourably spoken of by experts. In the meantime the ordinary buyer will find mechanical salvation in selecting a car backed by the name of an

established maker. Logically, of course, this advice cannot fail to be disheartening in the extreme to the original designer.

"How can my machine ever become known?" he will exclaim, "when the public are advised not to give me a trial!"

The question is apparently unanswerable, but in practice the building and selling of motor-cars have very little in common.

During their war work some engineers had an excellent experience with engines for aeroplanes, and it is not unreasonable that on their return to civilian work they should wish to make use of their extended knowledge. One has in mind three cars that have what, in 1914, would be called revolutionary engines. The one, which also has a very clever chassis design in general, has a 5-cylindered air-cooled radial engine: the second has a 3-cylindered air-cooled engine of much the same type; the third has a 2-cylindered air-cooled engine of the opposed type. There has been no opportunity of giving any of these vehicles a practical road test, but it may be said at once, that in the shops the engines have given very remarkable results, and there is no reason, so far as can be foreseen, why they should not prove similarly successful in actual service. They should be light, economical, powerful, and long-lived, and their constructional simplicity is a strong point in their favour.

CHAPTER IV

AN INTERESTING DEVELOPMENT OF THE LIGHT CAR IS THE POPULAR, LIGHT, FOUR-SEATED TOURING CAR

IDEAS come slowly to industries as to people; or, perhaps, to be more accurate, sketchy ideas come quickly, but the transitionary period, marking the space between thought and practical application, can be almost infinitely prolonged. The average car owner cannot be accused of too great a knowledge of practical manufacturing considerations. It is unfortunate, but true, as makers have cause to appreciate. Even an elementary experience of workshop possibilities and conditions would, often enough, check the putting forward of unreasonable demands.

As an example: In reply to a leading question a dissatisfied motorist said a month or so ago: "I want a car like the Rolls-Royce at the cost of the Ford."

An attitude of this sort helps nobody, because the motorist is always discontented, and practical men, absorbed in the hard facts

of a work-a-day world, have neither time nor money to waste on such moon-demanding people. One thinks along these lines when considering the problem of the light-weight touring car. Ever since the time when a petrol engine was first geared up to road wheels there have been far-sighted people who visualised the day when a powerful and silent engine would be installed in an extremely light body construction capable of carrying a number of people.

About twenty-one years of unremitting toil and experiment was needed before there was any sign of the dream coming true! Then one or two cars of the type so generally demanded had actually made their appearance and . . . the war broke out! The truth is, however, that progress suffered little, for the additional experience gained in the period 1914–1919, was of great value to the car builders. Motorists have not yet had an opportunity of appreciating this fact.

In the previous chapter it was suggested that, for all practical purposes, the two-seated light car could be placed in the 10 h.p. class, with price also having an important bearing on the matter. Broadly it is a good definition, in its way, but when this class of light car is provided, motorists want a light car which gives rather more accommodation, say four seats and a luggage carrier. It must be fairly clear,

even to the veriest novice, that a time comes when a 10 h.p. engine, no matter how efficient it may be, is overloaded. Practical considerations of strength, power, speed, and economy suggest that, with an engine of this power, the average two-seated body is all that may be justly imposed. But the designer is faced with the problem of finding, still keeping within strict limits in regard to horse power cost, extra power to carry a larger body together with an additional load of between 250 and 400 lbs. He can instal, of course, a 15 h.p. engine, but if he does he at once takes the car out of the class aimed at, for in this case both first and running costs would prove too great to be really satisfactory for the owner in need of a light car which must also be roomy.

Fortunately improvements in engine and chassis construction, greater skill on the part of coachbuilders, and the improved raw materials now available have opened up an intermediate course during the last [illegible] years. The difficult problem has been solved, simply by adding a little to the general efficiency of the whole construction. Some makers describe their light four-seated touring cars as of 11·9 h.p., and others stick to the 10 h.p. rating. The slight extra power developed by the very efficient engines has not been bought at an abnormal fuel cost, and there is one very curious point in connection with this class of car:

it is that the very fact of weight having to be saved and room provided without sacrifice of strength gave designers no option but to build most attractive vehicles. They had to build cars of the greyhound class, if the description be permissible.

It may be assumed that, from the engineering point of view, the development of the power plant and transmission gearing in these light-weight touring cars was a satisfactory job. Providing the name of a well-known maker be attached to the car, buyers need experience no foreboding in these respects. There are other problems that buyers may well concern themselves about. Springing, for example. On the suspension system depends the ultimate comfort of driver and passengers, and not unrelated to it, also, are matters of long car-life, tire and fuel costs. The average motorist may be unable to see any connection between a rusted spring and an increased tire bill, for example, but he may be very sure that there is one, and that the designer, at least, is very well aware of it.

The very lightness of the chassis itself demanded a low body. The low body, in its turn, meant suitable springing, and the two fitted in with the modern taste in car appearance. Constructors had no option but to stick at the task of evolving a satisfactory suspension until they were successful. A few years

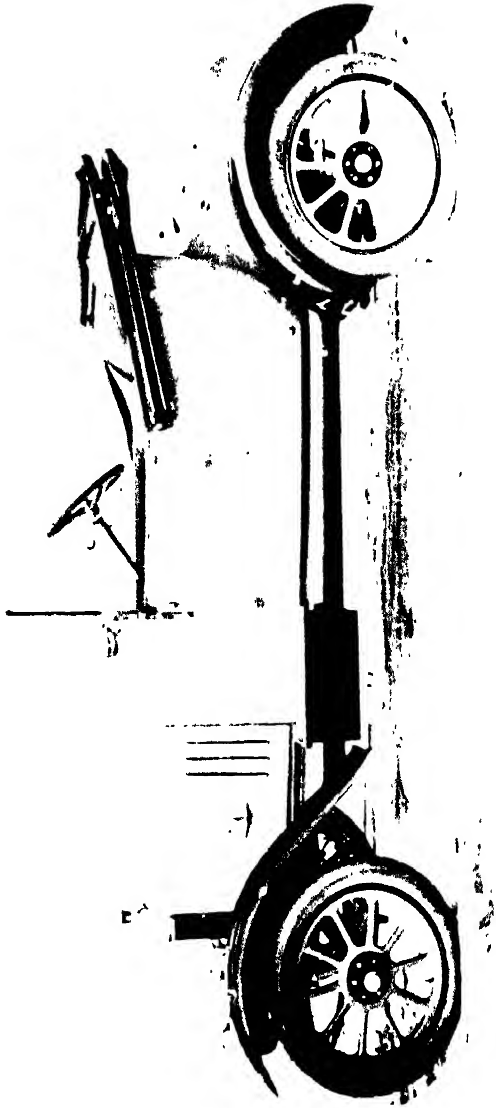
ago coachbuilders would have proclaimed the impossibility of producing a four-seated body within the space limits allowed. The combined pressure of car manufacturer and motorist has forced his hand in this respect. Now he knows that car bodies need not follow the constructional ideas of mediaeval castles: that weight does not necessarily mean strength in every case: that badly designed surfaces give increased wind resistance, and this, in its turn, slower speed and greater fuel consumption: that the space taken up by a graceful outer bulge in the car body may be made use of inside, and so on. In direct consequence the motorist now has his light four seated car which is economical on tires and petrol, graceful in appearance, trustworthy enough in the mechanical sense for tens of thousands of miles of running, and easily maintained.

At present there is a disadvantage attached to this class of car. Its first cost is too high. In this it is not peculiar. In 1914 several of the leading English makers had produced very excellent cars of the type. The writer drove one for just over 1,000 miles of very give-and-take roads, and in that period there was very little fault to be found with the car's behaviour on the road. The price, completely equipped, was £310, and at £250 the maker could literally have sold the machine without difficulty in thousands. Perhaps, if the questions of raw

materials and labour can be satisfactorily settled in the near future, an attempt will be made to reduce the present price.

A very popular light touring car built by another maker was of the "sporting" type. Speed coupled with a low fuel consumption, together with a general all-round economy, were the outstanding claims for the vehicle, which very quickly became most popular with owners. Unfortunately the selling price of nearly £350 was far too high in pre-war days, but curiously enough, although the price is now greater still, it has not increased so much as some other cars, and therefore, in comparison, it is not now so expensive. The car has a guaranteed speed of 60 miles per hour, with a fuel consumption of about 35 miles per gallon. The average owner of a light touring car does not, however, want speed at all costs; he prefers economy, and is quite content to do 40–45 miles per hour on the level. Because the high-speed engines generally used in these light touring cars are very well balanced, there is no objection to their doing most of the work in traffic and on hills on the lower speeds.

Quite a number of enterprising manufacturers were giving serious consideration to this light touring car when the war broke out. Their machines have, on the whole, stood up very well in four years of strenuous work over poor roads, with little chance for overhaul and



repair, and in the hands of poor drivers. The post-war vehicles are improved in detail, the coachbuilders have used every available inch of space, and, although the machines are really not intended to accommodate four heavy people and luggage in comfort on long journeys, they most certainly are capable of carrying four ordinary passengers with light luggage—though some little ingenuity is needed in arranging for its stowage without inconvenience.

Much must, of course, be sacrificed to lightness. It is debatable, for instance, whether it is worth while fitting an engine-starter, especially of the electric type which, with its motor and batteries, weighs some good few pounds. A little further post-war experience will settle the question more definitely, and until then it may be said that at some little cost in extra fuel and speed, and on the purchase price, a starter can be fitted, especially when a dynamo-driven electric-lighting set is already installed. Failing this, some form of spring-driven engine-starting appliance will probably find favour. Actually these very efficient, high-speed engines are easily started by hand, without great physical effort.

An interesting situation has arisen because two big motor manufacturers, one French, the other Italian, promise to invade this light touring car market with very completely equipped cars which are to sell at about £300.

Of course the tax, which is based on the cost of the car in the country of origin, plus insurance and freight, will at least level this up; but one wonders whether any British concern is prepared to build here at the same low cost. Both of these Continental makers have huge works organisations and, if they turn to the task seriously, they will undoubtedly put out very promising cars.

Summing up the light-weight touring car it may be taken for granted that it is mechanically satisfactory in every way, or, at least, is as much so as its bigger sisters. Its accessories are equally satisfactory; it gives equal protection from the weather; it is not so very much cheaper to buy, but is, unless of the "sporting" type, very much more economical in upkeep. Against this it cannot give the same convenience and comfort for long cross-country touring, and, a very important point, it must not be overloaded or overworked. Because though a 10 cwt. four-speed 10 h.p. car will, at a pinch, carry six heavy people up a hill, it by no means follows that the springing and the transmission are any better for the performance—rather the reverse, in fact. Potential owners should consider very carefully what work they are proposing to inflict on the car. Should it be decided that the task is reasonably within the powers of the vehicle, the question of comfort obtrudes itself. The

best way to settle this problem is to arrange for an extended cross-country journey in the car under consideration. Opinions can be arrived at afterwards.

A light, enclosed body on chassis of this class will serve doctors and business men exceedingly well. For shopping and for social work similar machines are particularly attractive to ladies. Yet one must be continually on the look out to prevent overloading. One of the most fascinating cars of the type to come to the writer's notice had a completely enclosed body like a big limousine, with windows practically all round. Only one door was provided, but three seats were built-in, each of the swivelling, adjustable type. These were practically set on the level of the floor, and exceptional luxury was given by the very deep upholstery, which also raised the passenger high enough for comfort. The seats of themselves took up very little room, and the car is always in great request. A body of this type may, however, easily add £50 to £100 to the first cost of the car.

A word about the running costs of this class of vehicle may be of interest. In the past there has generally been a tendency, in print, to understate running costs. It is a mistake. During four years of war, during which the car referred to above was constantly in use, the actual cost—which covered everything: differ-

ence between buying and selling, insurance, repairs, petrol and oil at all sorts of prices, curious expenses unlikely to be experienced in ordinary times, interest on outlay, and, in fact, every possible cost—came out at $4\frac{7}{8}d.$ per mile. The owner was a careful man and kept very complete figures. The selling figure was, of course, very high during the car shortage of 1919.

High as the figure may seem it should be remembered that, for the most part, the full complement of passengers was carried, and that petrol and oil costs were higher than they are likely to be in the future. For three people the cost compares very nearly with that of railway travelling and other means of transportation, leaving comfort and convenience out of the question altogether.

CHAPTER V

THE POPULAR FIVE-SEATED TOURING CAR ATTRACTS BOTH MOTORISTS AND CAR MANUFACTURERS

PROBABLY the most popular car in Great Britain, and on the Continent also, in pre-war days, was the medium-weight touring vehicle. It afforded accommodation for five people and a quantity of luggage; its engine was of any power between 15 h.p. and 25 h.p.; it was a substantial and solid machine, weighing between 15 cwts. and 25 cwts., and its selling price varied between £350 and £500. On the road its top speed, fully loaded, reached fifty or even fifty-five miles per hour, and the petrol consumption could be so good as twenty-five to twenty-seven miles per gallon, and down to twelve to fifteen miles per gallon. The average owner called the former mileage figure luck, and consoled himself with the thought that the abstemious car had no power on hills, while he spoke of the lower mileage as jolly bad driving, making a mental note to be thankful that he himself was not as others.

How many makers produced cars of this type? About 75 per cent. of them all. Some

specialised in the car, while others merely included it in their range. Additional complication was introduced by the fact that the same type of car was also very popular in America, and U.S.A. makers were rapidly gaining a foothold here by offering vehicles which were very much more completely equipped, and of rather greater horse power, at the same, or even at a lower price than our own makers asked; or, alternately, offering similar machines, which were hardly so comfortable, however, at a strikingly lower cost.

Despite the advances made in the building of other cars it must be admitted that this medium-weight touring machine has lost little, if any, of its popularity. It is an excellent general purpose car—a serviceable, bluff sort of car, capable of being maintained in good order without the help of a paid chauffeur. The owner may drive himself at a not ruinous cost; or he may load up with his friends or his family and indulge in a 200-mile trip at very little greater cost per mile than when the car carries the driver only. It is the doctor's car, the professional man's car, the ladies' car, the touring car; in fact, it is a dozen cars rolled into one, providing its owner be of not too exacting a temperament.

And it has had disadvantages in the past. For example, it was not light enough. Now lightness is not to be achieved simply by

cutting down weight wherever a part seems unnecessarily cumbrous: it is more a matter of sound design and the use of fine materials. The 1914 medium-weight touring car could, with the materials then available, have been cut down on an average from 3 to 5 cwts. without approaching or encroaching on the safety margin which every designer who knows his business now insists on.

One gets nothing in this world for nothing; the only thing one may get a lot of for very little seems to be trouble! But it will be obvious that the cost of carrying 3 cwts. of dead material along, at all speeds between one mile per hour and fifty, is not inconsiderable. It would take a horse all his time to do the work, while the combined physical efforts of two men could not do it: yet the owner of an average touring car in 1914 had to pay for its being done without any option.

There are two great reasons why the weight must be and is being, fortunately, reduced. One is that it is stupidly unnecessary, and the other is that the manufacturer has to buy the material and pass it on to the car buyer at a commercial profit. During the war much progress has been made in metallurgy and manufacturing processes, and so soon as full delivery of raw materials is available, it will be found that additional lightness can be given without sacrifice of strength. Incidentally,

there will be some saving in cost, and if this can be passed on to the car buyer, so much the better.

The most popular pre-war car of this type was made in Coventry. Ready for the road, with a five-seated body, it sold for £350. It was the Rover "twelve," which, slightly improved in detail and with an electric-engine-starting and lighting set, sells in 1919 for £700. In 1914 the maker intended, so it was rumoured, to equip the machine with an electric-lighting and engine-starting set without increasing the selling price to the public. The car had a four-cylindered engine; an essentially simple clutch took the power to a three-speed gear-box, and thence the drive was by propeller shaft to a worm-driven axle. There was nothing complicated about the engine or transmission. It was a good, simple job from beginning to end, and buyers appreciated its strength and simplicity. With a lighter body and some saving in weight on the chassis—it could be done by the use of stronger and lighter, though possibly more expensive, materials—the car could hardly be bettered in its 1914 class.

A round score of other makers have been building cars quite as good mechanically which, however, failed to suit the public taste so exactly. The taste of the car-buying public has quite a lot to do with the success or other-

wise of a car. Advertising may sell a few vehicles that differ from general practice, but advertising on a stupendous scale would be needed to sell an odd-looking car in thousands—the question of "oddness," be it noted in passing, being very largely a question of what people are accustomed to.

The point is well made by considering the cases of two cars. One is a light car, which has the engine located to the back of the chassis and a sort of bonnet—a dummy, in fact, but a concession to public taste, used, more than anything else, to give leg room to the driver. Although the general lay-out differed widely from the orthodox the builders very wisely decided that in outer appearance the car should not be unusual. In consequence great popularity followed. The second car is an expensive machine which, for sheer engineering ingenuity and sound design and construction, would take a lot of beating. On this second car the engine, springing, steering, and a dozen other features, are out of the ordinary; they are outstandingly good, as has been proved on the road as well as in the lecture-room and the workshop; but the general public did not show any great fondness for the car, although the full output of the works was always sold to discerning buyers. After a fight of some years, however, the maker found it easier to make concessions to

the popular idea by making the cars, to outward seeming, conform more to the ordinary. Pioneer work and educating the public is a painstaking and costly business when motor-cars are concerned. *This in passing.*

No doubt those other makers who were successful in a business sense, but whose cars were not "the rage," will also lighten their products for 1919 and reduce the price so soon as possible. The shape of a radiator, the sweep of a wing, the colour finish of any of these cars may sweep them on to a wave of popularity. No designer ever knows. He can only hope and pray.

In this medium-weight class of car were many comparatively expensive machines. One, rated as a 12–16 h.p., has proved extraordinarily successful. Before the war and in 1914–1915 it sold complete at £485. Experience in the building of very successful aircraft engines will probably induce this maker, as well as others, to improve the cars by fitting six-cylindered engines in place of the four-cylindered units. The power will remain practically unaltered, but some additional sweetness in running may be expected. A third very successful car was the Crossley, which was adopted by the Royal Air Force. This vehicle was on the expensive side even in 1914, but, of course, it was distinctly superior, tending rather to the "luxury" class. Preparations

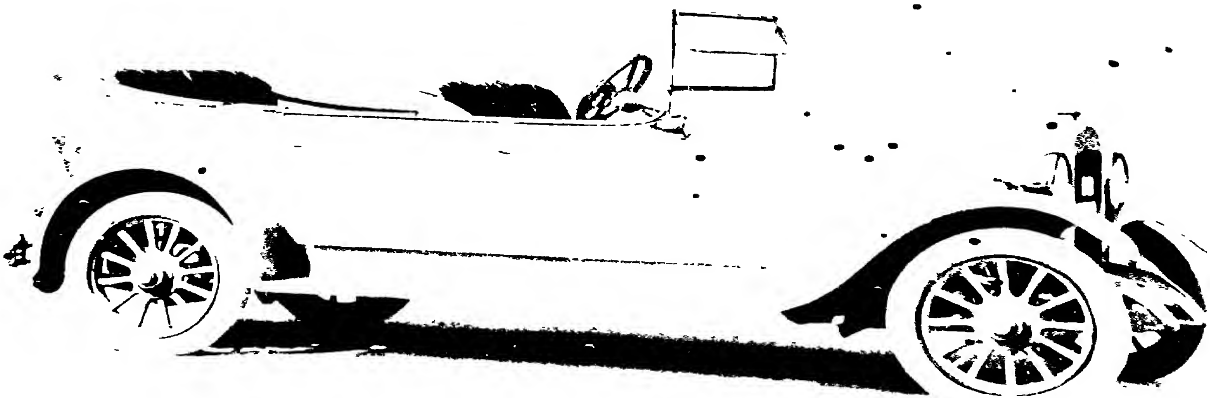
are now in hand to manufacture Crossley cars on a big scale, but the chassis price, alas, is £850 with electric-lighting set and engine-starter! *The R.A.F. made rather a point of fitting twin pneumatic tires to the rear* wheels of these cars, especially those pressed into service as light tenders. If a car of this class calls for twin rear tires there is something radically wrong with the design, unless it is being used for exceptionally strenuous service. It is not necessary with the Crossley 25–30 h.p. chassis. The truth of the matter is that many cars are undertired, the makers foolishly trying to save a sovereign on first cost by fitting too small tires; in addition to increasing tire costs this procedure decreases the comfort of the passengers and shortens the life of the car.

There is no startling difference of opinion between designers of the transmissions in these medium-weight cars. For the most part they are on quite orthodox lines, but here and there the individual designers work in features which add materially to constructional value. A four-speed gear-box is more expensive to build than a three; and, if it be properly used—which it very rarely is!—it is worth the additional cost. On the other hand, the engines fitted have quite a respectable reserve of power, and, so far as the average driver is concerned, the three-speed gear-box is amply sufficient

for all purposes: there is some slight saving *in weight, and there ought also to be in cost, when the smaller box be fitted.*

A bevel-driven back-axle can be noisy if it be ill used, and when more or less worn. Careful use, however, can ensure a sweet, quiet-running axle for a great many thousands of miles. In practice, a worm-driven axle is quieter and, before wear takes place, more efficient. The efficiency, however, falls off far more rapidly with the worm as wear takes place than with the bevel drive. Here again there is, so far as the better known types of car go, little between one and the other. The extra power of the engine dictates that an electric-lighting and engine-starting set be a standard fitting.

For the owner-driver it is not unreasonable to ask that the accessory range be very complete indeed. There should, for example, be permanent jacks fitted so that the car can be jacked up in the minimum of time and trouble. The wheels themselves should be of the quick detachable type. There should be a tire-pump driven by the engine. A very useful fitting would be an engine primer of some kind, for, although an ample-sized battery for engine-starting purposes should in all cases be installed, there is no sense in carrying too big a battery. Nor is there very much sense in exhausting it by turning a stiff engine on a



A THREE-QUARTER VIEW OF THE AUSTIN "TWENTY" CAR

[illegible]

cold winter morning when, by fitting a cheap and simple primer, the load on the starter can be reduced by 50 per cent.

The touring car should have a double screen and a nicely fitting hood. When hood and screen are set there should be no crevices and slits whence rain and wind can beat through. Except on one American car the writer has never yet come across any car complying with this condition; but the fact that one car did, proves that it is not impossible. The engine power and the wheel base both being ample, the coachbuilder should provide ample leg room for everybody, and there ought to be little difficulty in arranging also for ample locker space for tools and luggage.

It follows that the remarks about the hood should be amplified to the extent that when the side curtains are fitted complete protection, even from heavy and continuous rain, should be given. These curtains should open and close with the doors. An improvement in appearance would follow if the hood, when folded, fitted into the coachwork of the rear seats, as in the case of the Austin car for 1919; and it is important, in any case, that it should be so designed that one person can easily hoist it into position in a heavy wind. Presumably the majority of the "one-man-hoods" are so called because at least two people are needed to get them into position?

CHAPTER VI

THE SPORTING TYPE OF BIG CAR IS EXPENSIVE TO BUY AND MAY BE COSTLY TO RUN

In a previous chapter it was pointed out that there is some little difficulty in drawing a clear hard line between the different classes of cars. The manufacturer whose own natural inclination runs towards sporting matters is in danger, unless his commercial sense comes to his rescue, of supposing that his own inclination, supported naturally by the somewhat similar inclinations of his personal friends, of thinking that the average car buyer is also a sporting character in need of a sporting car.

Such a maker would rejoice in seeing his machines lapping the Brooklands track with just a few seconds on record in hand. Incidentally, the feat might have a favourable effect on sales. But against it must be placed the fact that the average car owner does not want a record-breaking machine: he has rather set ideas of what his car must be capable of doing. The manufacturer who best understands this public desire, and backs it up by sound organisa-

tion in the factory, coupled with cleverly consistent advertising outside, is more nearly calculated to find great commercial success. Possibly this sounds rather obvious. The truth is that it is not so obvious as it sounds. One recalls a conversation with a clever car designer who remarked: "I'll change that silencer of ours. The k'nuts who buy our cars want to hear the exhaust booming. It seems to add five miles an hour to the speed in their opinion."

The car in question sold for over £650 in 1914, and although there was certainly a small market for a thunderous, booming sort of machine, one would have thought that greater sales could have been had by combining the absolute silence, power, and luxury of the car, and appealing to the better class of quite private buyer who dislikes ostentation. The fact remains, however, that whether the market be small or not, it exists, and some manufacturers like to cater for it.

Let us consider, then, the costly speed car capable of taking a full load of passengers and achieving a speed, with full road equipment, of up to seventy-five to eighty miles per hour . . . if drivers there are with nerve enough to make the speed, and prepared also for the legal consequences. Be it noted, however, that although a great many of the ultra sporting type owners talk of speeds like these, it is

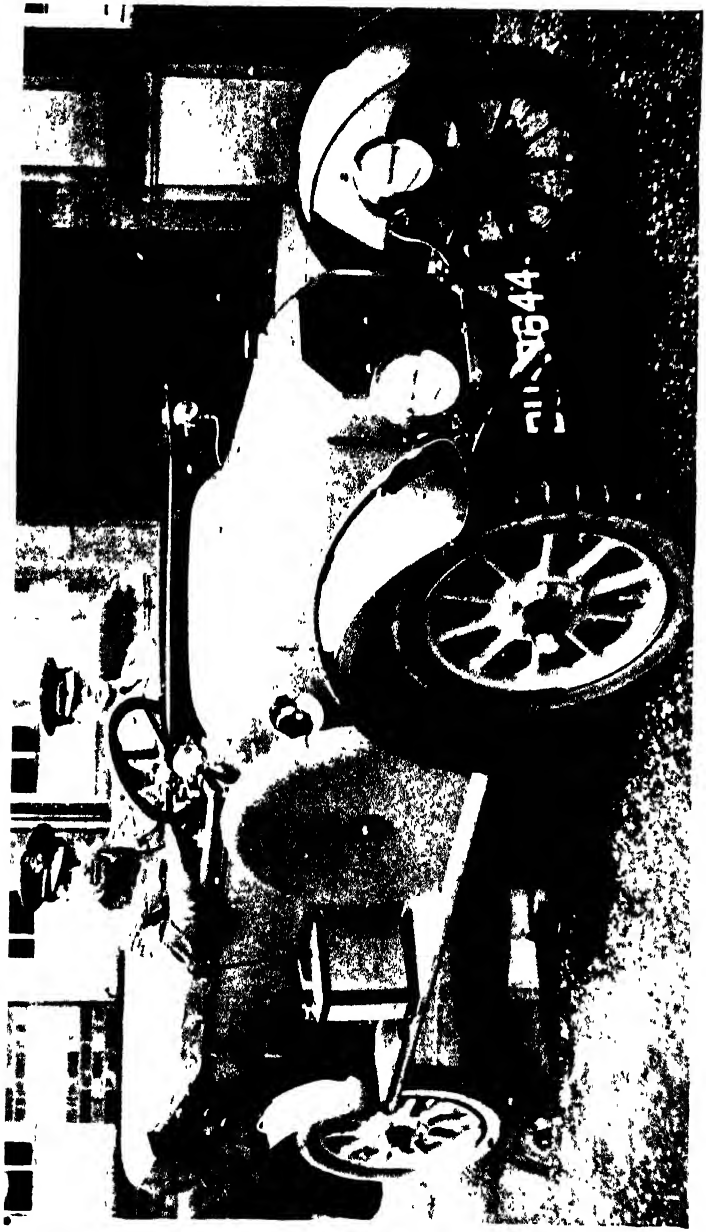
debatable if one in twenty actually understands what they mean.

In the first place the chassis with tires will cost somewhere between £600 and £1,000. It will have either a four- or a six-cylindered engine which, because of the extended aero engine experience of the manufacturers during the war, will differ from pre-war practice in that valves of the overhead type will be fitted.

There are undoubted advantages following their use, but until quite recently there were perfectly sound reasons why poppet-valves were preferred as a general thing. The difficulties have now been overcome and, in consequence, high-speed overhead engines will be even more efficient than before.

It is not to be assumed that these costly and high-powered machines are necessarily expensive in regard to fuel. The writer handled a car of 25 h.p. R.A.C. rating—the actual b.h.p. being very considerably more—over about 1,000 miles of give-and-take roads in 1914, and was very agreeably surprised to find that the average petrol consumption worked out at twenty-four miles to the gallon. This despite the fact that the car carried a fairly heavy body, with three passengers and luggage, and, at Brooklands later, lapped at over eighty-five miles per hour.

A big clutch of the type most favoured by the makers—probably a multiple-disc—will



take the power from engine to the four-speed gear-box, and thence the drive will be by propeller shaft to a bevel- or spiral-bevel-driven back-axle. In other types of cars designers favour worm-driven axles, but for the fast, powerful machine the tendency is in favour of the bevel.

There is, in practice, little between the two. Not so very long ago the bevel gear was rather more noisy, but manufacturing improvements and the use of better materials have overcome this weakness. Against this is the fact that the worm-driven axle is, until wear takes place, rather more efficient, but the degree of wear necessary considerably to reduce the efficiency of the drive is small. The spiral bevel is the latest development.

A combination of unfortunate circumstances can speedily bring about wear, and then the falling off is rapid—far more rapid than is the case when a bevel-driven axle begins to wear. Nor is it so easy to arrange for any wear to be taken up with the worm as with the bevel drive without dismantling the whole axle.

The choice is a matter of personal preference. It may be assumed that no responsible maker would select either for his machines unless he were perfectly and completely satisfied that, all things considered, there was some good purpose to be served. One may discuss the matter theoretically for hours, balancing one

fact against another, and come, in the end, to the conclusion that on the road there is little in it. The writer has driven many cars of both types many thousands of miles without having the slightest trouble with a single axle, bevel, or worm; and as for power, efficiency, and silence there is no bad word to be said of most.

Providing the brakes be of ample size there is little objection to their both being located on the rear wheel drums. Size, which allows of ample braking effect and a sufficient cooling area—the cooling should be assisted by fins cast on the outer casing and facility for adjustment must be the deciding factors.

It is possible, of course, though somewhat unlikely, that one accident may put out of action both brakes when they are located together on the rear wheels. Danger could be avoided by providing a third emergency brake to the rear of the gear-box. The latter would be an ideal system, but most makers prefer to have the side brake operate on wheel drums and the foot brake operate on a drum located between gear-box and back-axle.

In practice the scheme works well, although when the car is roughly handled the foot brake, brought into constant and unintelligent use, can impose undue strains on the transmission — strains that quickly result in wear, noise, and a falling off in efficiency.

For a car of the type under discussion semi-

elliptic springs have, perhaps, more advantages than others. They are not so luxurious as the cantilever springs, but, on the other hand, the speedy car must have little tendency to roll or it would be an extremely uncomfortable machine to ride in, apart from any tendency it would have not to hold the road. Carefully designed semi-elliptic springs, which should be almost flat when the car is normally loaded, are not given to rolling nor to the setting up of periodicity at given speeds; and, because the *speed lover is not so solicitous of his comfort as other motorists presumably, the very slight lowering of the luxury standard is not noticed by him.*

Electric lighting is essential. In fact, one may take it as essential on every post-war car, from the lightest of two-seaters to the six-seated limousine; but it is doubtful if a mechanical starter is necessary. Its added weight in a car of the kind is not inconsiderable, and although the engine may be a "hefty" specimen, it follows that its owner will also be "hefty" in his turn; and, more, that it will be his business always to have the car in the pink of condition and "tune," otherwise the desired speed would not be available. Because of this, the engine should start quite easily by hand. A hand-operated magneto which would, five times out of six, start up the engine when it is warm should be fitted.

Detachable wheels are indispensable. They could be improved by fitting discs, and by having the rims of the contractile variety. In the design of the body room should be found for two spare wheels in the rear of the car; failing this the wheels should be mounted on a spindle and locked in position on a coarse-threaded hand-screw. The running board is an unsuitable position for the housing of spare wheels on a sporting type car.

A single screen should be fitted, and the hood should, when not in use, be housed in a compartment specially built for it which conforms to the general shape of the body. Special attention should be given to the disposition of the tool-kit. As a rule, makers have in the past bought a cheap German set, enclosed in an imitation leather case, and have thrown it, together with an undersized and totally inadequate jack, into the boot of the car, which they then proceeded to describe, erroneously, as "fully equipped and ready for the road."

A little thought and a small extra cost will dispose of an excellent tool set either in pockets on the inside of the doors or in drawers housed on or under the running boards. In either case the tools come easily to hand, are easily replaced, stand up to their work, and earn the car builder more solid gratitude than is generally believed.

The sporting car is not, in its nature, a

" gadget " machine. It is a simple mechanism in which speed, efficiency, and power are the main considerations. Owners, therefore, must look for neither very elaborate finish, equipment, nor low selling costs.

The freak sporting car is best avoided. The average maker can give all the speed and power needed by a little alteration of valve-gear on the engine and gear ratios in the gear-box and the back-axle of his standard touring machines, and there is the satisfaction of knowing that, in case of need, replacement of parts is neither a ruinous nor a lengthy job, although, of course, it would be foolish to overlook the often-repeated warning that speed must be paid for—occasionally in the police court, always in petrol, oil, tires, and general wear and tear.

CHAPTER VII

THE LUXURIOUS CAR IN WHICH COST IS NOT THE FIRST CONSIDERATION

FROM the sporting type of car one comes to the bigger, more luxurious, touring and town vehicle. Here the buyer gets a combination of speed, power, and luxury; and, naturally, pays for it. He does not pay exorbitantly, be it noted, but he certainly does pay the difference between third- and first-class traveling. Whether the extra cost is worth while or not is a matter for individual settlement.

In any case there are thousands of people willing to buy luxurious cars regardless of first cost; there are some few who are unconcerned about running cost, though, in practice, the rule is that the owner of a £1,000 machine is more careful of his running costs than the owner of a little two-seater. Probably the carefulness that has put it in the power of the former individual to pay so much for a car in the first place has something to do with it.

In England are a very few manufacturers whose products have set a standard of quality

to the world. Even in America there is a big market for the purely luxurious car, and some chassis of U.S.A. origin cost even more than the most costly English-built car. But in the face of this, however, the best of the English cars bring a higher price in the States than the best products of the native factories.

At first sight it would seem that the big, costly car must of necessity exceed in upkeep cost a cheaper machine. Further consideration will show that the smoother running of the engine, the better balance of the car generally, the ample engine power, the absence of vibration, and a score of other important factors, all tend to reduce upkeep cost. The extra 5 cwts. mean, logically, bigger and costlier tires in the first place, but on the credit side must be placed longer tire life, greater comfort in riding, greater cushioning of the chassis generally, and a consequent reduction in wear and tear, more freedom from tire troubles, and, because of all these things, a smaller repair bill generally.

The same reasoning may be applied in a dozen different directions with equal accuracy, and the fact is that there are at present in service dozens of cars, costing over £1,000 in the first place, with tens of thousands of miles to their credit, whose repair bills are less than £5 yearly. In war work in many countries it was found that the most expensive cars stood up

be had, it has not been largely adopted. As cost and manufacturing considerations have little to do with the matter in these expensive cars, one presumes that most makers have not so far been convinced that their own practice could be bettered.

Very obviously an electric-lighting system is needed, and, equally obviously, an engine-starter. It is important that these fittings should be standardised with the chassis: partly so that the designer of the fittings might have in mind the special engine for which the parts are intended, and partly that the car designer can allow for the accessories in his plans, and provide reasonable accessibility for adjustment and repairing purposes.

The existing system of car taxation is far from satisfactory. It seems to be a part of human nature that a man will pay £1,000 for a car and grumble exceedingly when called on to pay some comparatively insignificant sum afterwards. There are people who, rather than pay a tax of £20 for a big car, will buy a machine which is even more costly, but which is taxed on a lower scale.

Because of this little trait on the part of buyers, there is a tendency for some manufacturers to underpower their big chassis. Unfortunately when owners have paid a big sum for a car, they naturally think that the machine should take the heaviest of bodies,

only to find, later on, that the engine is overloaded. The point is made here for the benefit of those buyers likely to turn too ready an ear to seductive talk of: "This car, you see, sir, only pays a tax of £8 8*s*." Possibly, however, the tax on machines will shortly be remitted in favour of a tax on the petrol consumed.

In the cheaper cars there is plenty of material for debate as to which fittings should be standardised and which should be fitted—and paid for—by the owner after taking possession. In the costlier machines there is little room for argument. The maker should fit every accessory conducing to the possible comfort or convenience of the passengers.

The engine power should be able to meet all demands made on it, and the springing should have an unusually wide range.

The one test should be whether an accessory or fitting manufactured by some outside firm is sufficiently trustworthy to be incorporated in the chassis. One can hardly blame the maker of a really excellent engine if he, for example, refuses to standardise some make of starter which, in his considered opinion, is liable to failure in service. Users are not always reasonable, and are sometimes apt to condemn a chassis because of the failure of some minor accessory.

Given, however, 100 per cent. efficiency, every accessory should be supplied with the

chassis. For example, during the war much progress was made in the design of lifting jacks. Previously one had to carry a detachable jack in the tool kit. The jack selected was not always suited to the chassis, nor was provision always made for its employment. Jacking up a big car is a laborious and not very clean job at best, and the latest practice demands that the jack be an integral part of the construction and that it be operated by the engine power. Further, instead of a jack simply lifting one wheel, the whole chassis should be lifted clear.

A mechanically-operated tire pump is also a necessity. It should deliver clean, cool air, and cut itself out of action when the stated pressure is reached in the respective tires. A water temperature indicator should be fitted, and provision made for regulating the heat through louvres actuated at the driver's discretion from the dash. Detachable wheels and contractile rims are very obviously needed, and room should be provided for at least two spare wheels, which should form part of the standard equipment.

Very rarely, in European practice, eight-cylindered engines have been tried in this luxurious car class. There is something to be said for this engine, and also something against it. It is not altogether on the score of extra manufacturing cost that it has not found

greater favour, for, curiously enough, the eight-cylindered unit is more simple to build than a six. Nor is it altogether a matter of extra power, for designers have always in mind nowadays greater smoothness and economy in running than super-power.

In the U.S.A. the eight-cylindered unit is in great favour, and some makers have even produced successful twelve-cylindered cars. Actually, what seems to be the case is that English makers in particular have brought the six-cylindered engine to such a pitch of perfection that until a similar state of efficiency is reached with the "eights" and the "twelves" there is not sufficient inducement to justify the change. Of course American practice, and the greater experience of English makers in building multi-cylindered aero engines during the war, will have some effect on future designs.

CHAPTER VIII

HOW THE COACHBUILDER WILL SET HIMSELF TO KEEP PACE WITH IMPROVED CHASSIS

In the coachwork of the future the motorist is justified in expecting great improvements. During the war many old-fashioned shops have been given their chance to modernise themselves; those that failed to take advantage of the opportunity will find themselves forced out of the running by the more progressive establishments. Many of the car builders themselves have during the war taken to the building of aeroplanes. This has led to the establishment of wood-working shops which can now be turned into coachbuilding departments.

Aeroplane construction calls for great strength coupled with lightness. In many of the pre-war car bodies we had great body weight . . . often enough in the wrong places! Few concerns ever standardised their products. The motor coachbuilders developed from the old carriage builders, and it was long before ideas and practice changed. When bodies

for the new mechanically propelled vehicles were needed, the coachbuilders did not sit down to consider the problem dispassionately. They merely wondered how they could build a dogcart or a brougham for use with a steam engine. It has taken nearly twenty years to get the problem regarded in the right light, and the old ways lingered right up to the outbreak of war.

Our Mr. Tooting Green, the eminent city merchant, on setting up house in the outer suburbs, took the opportunity also of setting up his carriage. The procedure was perfectly simple. He hied himself to a selected coachbuilder and stated his requirements with more or less an air of having been used to carriages. The builder would then produce an ornate, highly coloured sketch of some likely vehicle, and assure Mr. Tooting Green that the firm had had the pleasure, quite recently, of building an identical vehicle to the order of Prince Nanjaub de Boisis.

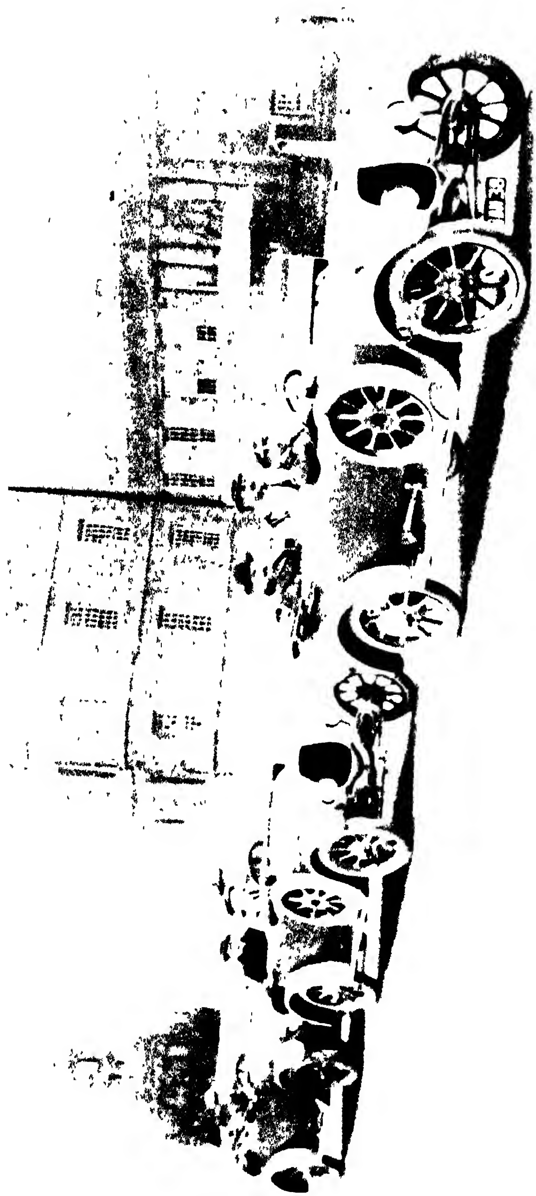
At a later date the builder would sketch out in chalk on a blackboard a life-size drawing of the machine, altered to suit Mr. Tooting Green's view. In time the work was finished, and, truth to tell, was creditable enough in its way. But only one vehicle was made. Modern methods insist that orders, to be truly economical, should be executed in thousands, even in tens of thousands.

When an enterprising light car builder gives a fixed order for ten thousand standard type bodies to be finished in one year to an equally enterprising body builder, that enterprising car builder can reduce the selling price of his completed product by anything between £10 and £20 per unit right away.

Coachbuilders now have a big variety of materials to work with. Possibly the cheapest of the light car bodies of the future will be of canvas—painted, varnished, and weather-proofed—and stiffened by wooden members. The saving of a hundredweight on the body of a light two-seated car or cycle-car would mean such an all-round saving that even if the body itself cost more the extra expense would be justified by the lower running costs.

As a matter of fact a canvas and wooden body would cost less. It could be made to look just as solid and substantial as an all-wooden body, and in wearing qualities it would be no whit behind.

The greater use of three-ply woods will also lead to a considerable saving in body weight. At present the cost of this material prohibits its extended use in the construction of the cheapest cars, but it can be used with advantage so far as the light touring and the costlier machines are concerned. Aeroplane practice has been of immense service in the matter of three-ply wood production.



In the third case, builders can produce an all-metal body. The Americans have developed the all-metal body far more than we have, simply because the scale of their car building has made it commercially possible. The U.S.A. coachbuilder can lay himself out to supply anything between 50,000 and 1,000,000 bodies yearly. He may supply the full requirements of one firm only, or he may sell to a dozen different concerns.

Even in the latter case the bodies built to one order would differ only in slight detail from those built to another, and many parts would be common to both. Manufacturing on this scale the expenditure of some thousands of pounds on dies and stamping machines is justified. In England, where before the war our biggest producer could count his annual output in quite a few hundreds of cars yearly, the expenditure could not be considered, at least not on the American scale.

Now, in view of present manufacturing intentions, the case is different. Our makers are not contemplating an annual output of over one million completed cars from any one factory, but they are thinking in thousands where previously they thought in hundreds and even in tens.

Metal has many advantages for coachwork. It is light, strong, and lasting. Also it takes a very fine finish. Against this must be set the

fact that unless extreme care and skill be shown it can be given a remarkably shoddy and "tinny" appearance. Whoever has travelled in the cheap body of an enclosed American car, and has heard the windows rattle in their tinny frames, will be able to appreciate, to some extent, the feelings of the German submarine crews chased by depth bombs. Frankly it is a disagreeable experience, and one longs for the heavy and expensive wooden body of European practice, "blowing the expense," so to speak.

The comparatively dark finish given to many of the American car bodies seems to have an additional advantage in that it "does not show the dirt" so easily, nor is it so necessary to be constantly at work with a chamois leather if rain spots, for example, are not to become a permanent disfigurement. Those, of course, who will have light colours on their car coachwork, must put up with the inconvenience of tar spots, which cannot always be avoided, and although there are ways and means of removing them, especially if they are tackled early, on the whole it is best to have a finish to the car that does not disfigure so easily.

A new type of body has become very popular of late. It consists of a thin outer shell fitted with as many doors as may be desired, though one, generally located by the near side front seat, seems to be the most popular. All the seats are adjustable. They are fitted to rails

or grooves set in the floor, along which they may be slid, the seats themselves being of the swivelling variety. A simple lever locks them in any desired position.

In almost every case the seats are light and simple constructions. Some are of the collapsible variety, so that in case of need they can either be folded up into a small compass or taken clean out. The whole of the body shell can then, apart from the driver's seat, be given up to luggage carrying.

At first glance this type of body may savour of the ultra sporting car—it lends itself very readily to this construction—and suggests that for long touring work it would not be altogether comfortable. Actually, however, because the seats are generally set very low, they can be made very comfortable indeed.

In the new cars coachbuilders will give greater attention to making better use of the space at their disposal. The ideal is to have everything ready to the driver's hand without any part being obtrusive.

There is, for example, an objection, which can be understood, to the use of spanners or tools before a spare wheel can be dismounted for use in case of roadside tire trouble. Broadly speaking, unless the spare wheel can be carried far enough forward to allow of a door being fitted to the driver's seat, it should not be carried on the running boards or par-

tially let into the wing at all. It can be housed on a spindle at the back of the car, or carried elsewhere in a special compartment.

If the vehicle is of the open touring type the hood, which should justify its name of "one-man," when not in use, should completely disappear from sight in a compartment built to receive it behind the seats. The whole body should be bolted to the chassis by easily reached bolts, so that, in case of thorough overhaul, it can be removed and placed out of harm's way.

Floor boards should be a good fit, and provided with both inspection traps and hand holes where needed to reach grease-cups or for adjusting nuts. When pockets to the doors are provided they should not be built to tear the hands to pieces because of projecting screws and pins inside. Actually pockets are intended to house small articles in constant use; the point has occasionally been lost sight of. The hood should be designed, so far as possible, to obviate back-draughts when it is hoisted, while the side curtains should open and shut with the doors. Ventilators should be simple and easily reached, and the slots in the footboards to accommodate the clutch and brake-pedals should be carefully cut, so as to prevent an icy draught sweeping through.

CHAPTER IX

A TALK ABOUT ELECTRIC-LIGHTING AND ENGINE-STARTING SETS

PRACTICALLY without exception the new cars will be fitted with electric-lighting sets and, in the medium and heavier machines, with electric engine-starters. There is, perhaps, just one type of car that will have neither. This is the cheapest and lightest machine, built specially for quantity-production and sale to those who desire to motor, but who, in return for low cost, are prepared to sacrifice comfort and convenience to an extraordinary degree.

In a few years even the "£100 car"—supposing that much-discussed vehicle comes down from the skies!—will not be complete unless it has a complete electric equipment, but for the years 1919–1920 there will be no cars selling at under £200 equipped with electric-starting and lighting sets. At this figure the equipment must needs be of a shoddy type likely to be more trouble than it is worth. As a matter of fact cars selling at £250, leaving out the simplest vehicles at £200, will be very few.

For anything over £250, however, the buyer is entitled to expect a thoroughly reliable electric equipment with his car, or at any rate a lighting equipment, even if a starter is not supplied. Prices will be very finely cut, and even if car makers can buy sets for £10 each, in huge quantities, the cost must be added to the selling price of the car, so that makers of low-priced cars will be hard put to it to include a number of modern fittings, and keep prices down.

For the modern light car, with its very efficient engine, the electric-starter is not an absolute necessity, even for the lady driver, for no great physical exertion is needed to start a stone-cold engine. At the same time a starter is a decided convenience. The engine can, for example, be started without stepping into the road, an advantage on a muddy day.

Possibly some very simple form of mechanical starter, hand or foot operated, will be fitted to take the place of the electric unit on the lighter cars—this is a matter for individual preference. Comfort demands the electric set, but economy may dictate something in the way of compromise.

For any car over 10 h.p., the complete electric outfit has come by now to be a necessity. The lay-out of the equipment is very simple. A small dynamo is housed somewhere about the engine, and generally is belt-driven

from that unit. There is a tendency towards fitting a more positive drive, such as gearing, and providing the whole is carefully designed, this, probably, will be the best practice. After a while a belt slips and needs attention, but the attention is quite elementary, and the slipping of the belt is at once noticed by an attentive driver. The belt has a big advantage in that it is the cheapest form of drive for a lighting dynamo.

When the dynamo reaches a set speed, the current generated is diverted to accumulators carried on the car, and these are in turn geared up to the lights and the engine-starting motor, or the former only when the engine is not electrically started.

The amount of current being generated by the dynamo, and actually in the accumulators, is shown by a volt and ammeter carried on the dashboard, and so long as the set figure be reached the driver has, in practice, little need for concern.

The lamps, of course, when in use, take their power direct from the accumulators, as also does the starter, and it is necessary to have the dynamo a few hours of running ahead, so to speak, in order that the battery may always be well charged.

Too large a battery or dynamo is an unnecessary extravagance, both in first and in running cost, and so a little common sense is

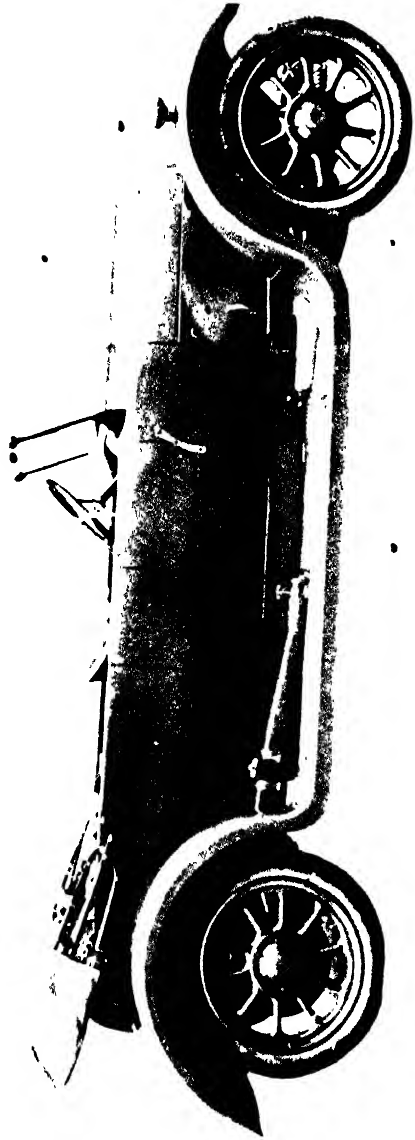
needed on the driver's part to see that he does not take too much current out of the batteries without recharging them from the engine.

In the summer, when the lamps are little used, the matter is not difficult, for the dynamo is charging up the accumulators practically all the time the engine is running, but in the winter, when both starter and lamps are in greater use, unless the car is used throughout the day, it may even be necessary at times to have the accumulators additionally charged apart from the car engine.

Actually the electric equipment built by the well-known makers is so reliable in practice that the average car owner hardly knows anything about it, except that he switches on the lamps at night, and starts the engine by the depression of a switch: and if this were so even in 1914 it follows that there will be no falling off, but rather an improvement, in 1919.

In America the car builders are divided in opinion about whether magnetos are needed when cars carry accumulators. The magneto is, of course, simply an electric machine for generating a current for ignition purposes, and, says the American maker, why should a special magneto be fitted when all the current needed is to be had from the battery, which is kept constantly replenished from the dynamo driven from the engine?

Accordingly, magnetos have been dispensed



with on many cars, the ignition being provided by current from the battery and a modern quick-acting version of the old-fashioned coil which was used before the days of the magneto itself. There are advantages on both sides, but so far, although the idea has been mooted in connection with the latest English cars, it does not seem to be in favour here. Even in America the more expensive cars are fitted with both battery and magneto ignition. The extra cost precludes this practice being generally followed, while the cheapness of the battery system inclines the makers of the cheaper and the medium-priced American cars in favour of it.

With our English electric systems the care now needed from drivers has been reduced to a minimum. The accumulators will stand up for years, providing they are not abused by being constantly overloaded and undercharged, and all that is needed is that the level in the cases be maintained a two minutes' job about once a month.

Now and again the dynamo driving belt needs a little taking up. In some cases the maker has provided facilities for adjustment: in others the belt has to be shortened. The driving surface must also be kept free from grease.

The car maker will see to it that all the cables of the electric equipment are carefully

housed and protected, and for the most part the car owner will only experience trouble owing to the chafing and wearing of the insulation of the cables—where they enter the lamps, for example. Frequent inspection is the best trouble preventer, and a little vaseline on the battery terminals will prevent corrosion there.

Incidentally the armoured cable now in general use for the purpose of carrying current on cars has many advantages over the ordinary cable, and its use should always be specified. When carrying out repairs all joints should be well and carefully made, soldered, and insulated afterwards. A spirit flux for the purpose is not to be recommended, for sooner or later corrosion takes place, the cable weakens, and eventually breaks.

The practice—not all makers, even in 1919, are free from something more than a suspicion of it—of regarding the electric equipment as an outside accessory is unfortunate. Almost certainly this way of looking at it leads to trouble for all concerned. Both dynamo and starting motor should be considered during the designing of the engine itself, and provision should be made for the housing of both in some suitable manner and place.

If the dynamo, for example, is to be housed on a platform, the latter should either be cast integral with the engine casing or, if the

designer prefer it, special bosses can be provided and the two bolted together. The objection is to the attitude which says: "Now we must allow for the dynamo! Here's room for it; let's put it here."

In cases such as this the matter of securing efficiency from the electric equipment is not considered, and although many users may be inclined to blame the makers of the accessories in case of trouble, there is also a distinct chance of the whole car being condemned as an unsatisfactory job. The average car buyer would do well to base his final selection on such simple judgments.

If care has quite evidently been spent in providing specially for those fittings which are not made by the chassis builder himself, it will, as a general rule, follow that similar care has been shown throughout the whole of the construction. The hint is well worth bearing in mind by those who are looking forward to the next Olympia Show to see what is on exhibition in the way of the latest cars and accessories.

CHAPTER X

THE PRIVATE GARAGE, AND REPAIRS THE OWNER-DRIVER CAN REASONABLY TACKLE IN IT

Because the millennium is not with us the perfect garage is not yet general by any means; in fact, it is rather exceptional to find a garage that is in any way near to perfection. In the immediate future it will be rarer still, for evidently the builders are going to concentrate for a while on the smaller houses, and these will not have garages.

On the other hand, when the factories get fully into their stride and labour conditions settle down somewhat we are going to see the production of cheap cars in considerable quantities, and all these machines will need to be housed. The Government, once on a day, thought that valuable cars could be housed for months at a time in the open, but the private car owner has not got the taxpayer behind him, so extravagance of this sort is forbidden him.

In America, where many working-class people have their own cars, the communal

garage system has come into great favour in the big towns, and probably something of the kind will be introduced here.

These communal garages are specially built, and the charges are as low as they can possibly be made. Users have a house just big enough to keep their machines in, water and light being laid on, so that owners can, if they prefer it, wash and look after the cars themselves. These charges are apt to make a heavy drain on the pocket of the average owner, and the worst of it is that in this country, although the garages profess to do the work and charge well for it, in practice the owner finds, when he has left the garage, that the work has either not been done at all or has been scamped.

If a shed of a suitable size be available it will in almost every case pay the owner to spend a few pounds and have it adapted for housing the car. The floor should be of concrete, and well drained. Water should be laid on. Electric light is an advantage in that it is always immediately available and is safe. Again, the garage should be well lighted and ventilated.

These things sound expensive, but in practice the cost of fitting up a shed in this fashion, spread over a period of years, is not really so heavy. Also the actual running cost of the car will be less, because care in the garage means economy on the road, and when a

vehicle is well housed depreciation is not unduly rapid and a better price is obtained when selling the car.

One really starts from the wrong end in this matter of garage accommodation, because so many new owners will soon make their appearance, and few of them will have a garage attached to their houses. In this respect the bulk of us must wait for developments. To the average middle-class house and the bigger places a garage has now come to be a necessity, particularly in the country. A word as to garage equipment will, however, not be misplaced here, because in the ordinary way the average garage is fitted up for almost any purpose but that of keeping a car in good running condition.

The concrete floor, as already said, should be sloping towards the central drain, and a good water supply should be laid on. The doors, whether of the ordinary or the telescopic or sliding type, should swing well clear when open, giving an unrestricted entrance. A pit, of course, is a great advantage when work underneath the car has to be done, but if a pit be not easily provided, a substitute can always be arranged by running the front or back wheels of the vehicle up steeply sloping boards until they are eighteen inches or a couple of feet off the ground; the lower wheels can then be scotched. A set of pulley blocks for use when

lifting any heavy part clear for repair is a useful adjunct.

A lathe is not indispensable, for not one owner in twenty has one, but it is a useful tool to have, especially if the owner or chauffeur is at all skilful in mechanical matters. There should certainly be a good sound bench provided with a heavy parallel-jaw vice. A blow-lamp will save its cost over and over again in the course of a few years; a bench-drill is an asset, and as for the rest a couple of pounds will provide, even in these days of high costs, quite a useful though simple assortment of files, punches, hammers, chisels, spanners, and wrenches.

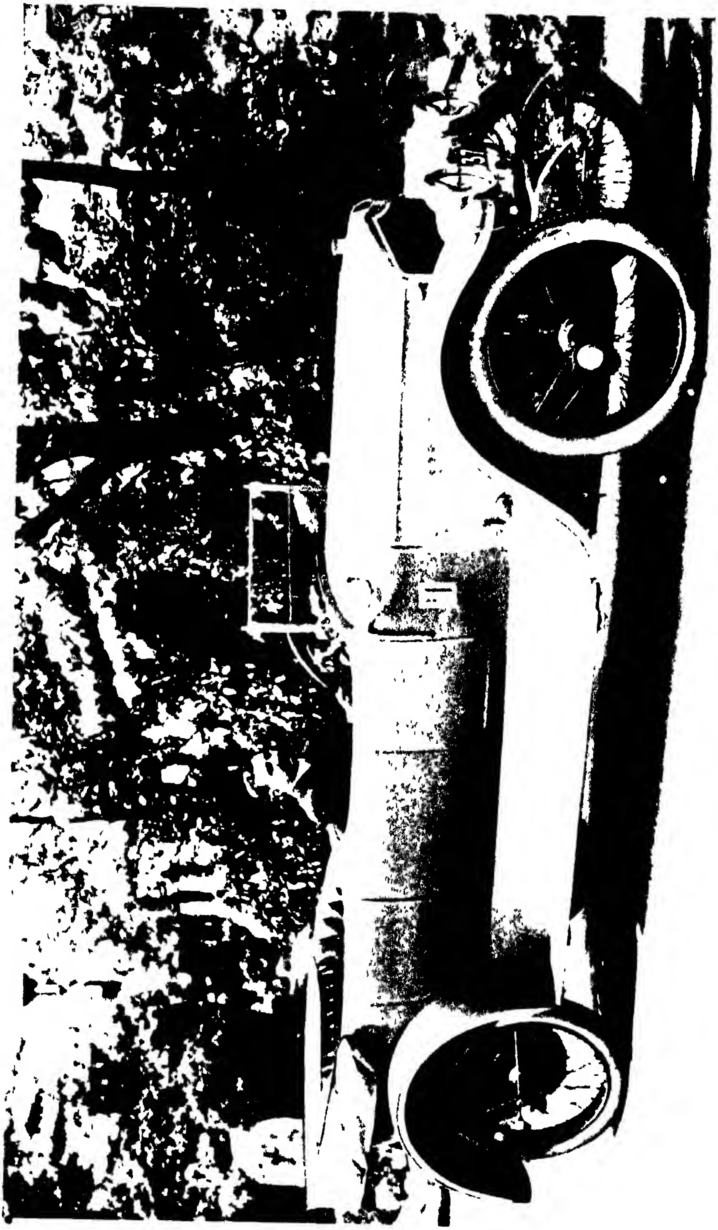
A box of assorted nuts and bolts and a selection of washers will prove valuable. Other tools and appliances can be added from time to time, or not added at all if the owner prefer to let the garage men do most of the repair work. Just as houses collect odds and ends of furniture, clothes, books, and lumber generally, so a garage collects spanners, short lengths of cable, bits of chain, odds and ends of sheet-metal, tubes, rods, bolts, soldering materials, blocks of wood, tins and cans, bottles, oil drums all of which, sooner or later, come in useful. Unfortunately, unless the owner be a careful and methodical man, the particular odd and end desired is never to be found at any given moment; but after the repair is done it seems to turn up smiling.

What sort of repair is in the realm of the ordinary owner and what should be sent to the professional? The owner, if he be of ordinary skill and patience, could quite easily tackle most running repairs. He can do almost any soldering job, with the exception of mending a radiator; this latter, a tricky job altogether, had best be left to the professional.

Cleaning the cylinders from carbon is a dirty but a simple job; adjusting the valves needs a little intelligence, and grinding them in a little patience and muscle. Taking up wear in the clutch and brakes is a matter of following the advice of the maker of the car, and if a man likes tinkering about in the garage there is no reason why he should not try more expensive repairs, such as taking up wear in the wheel bearings, on the big ends of the connecting-rods, in the steering gear, and in the gear box and back-axle.

But in most cases adjustments and repairs of this type are best left to the garage people. If the car be given the most elementary attention in running, and not over driven, it will be found that such repairs are not needed before many thousands of miles have been covered on the road.

As a sort of golden rule it may be taken that any trouble that develops on the road, unless it be due to structural fracture over which the owner can have little control, is directly due to



inattention in the garage. Take a simple lighting defect, for example. For weeks an owner will note that the cable, just where it enters the lamp, is frayed. But when the current is switched on the lamp lights up; in consequence, the owner hopes "it will last for ever," or, alternately, he "will do it some time."

And in nearly every case the cable chafes through and develops trouble, either just when a rush is being made for a train or at some other equally inconvenient time when delay is the last thing desired. Now if the cable had been carefully taped and insulated some time when the owner had a minute to spare the ultimate trouble taken would have been very much less. This sort of thing can, in the ordinary way, be multiplied by a hundred. If the late lamented Mr. Samuel Smiles had had to spend his days in the garage of the average car owner he would have lifted up his voice and demanded to know why he had ever been born at all.

Oils and greases are best bought in bigger quantities than is usual. This practice ensures that the right lubricant is always used, for, even when touring, if the various components be replenished before starting and a small tin of grease and a gallon of oil be taken along, some thousands of miles can be covered without need of trusting to oil or grease of an unknown brand: and unsuitable lubricant in engines and bearings can be almost as bad as none at all,

though owners without experience rarely believe it.

In nine cases out of ten the kit of tools supplied with the car by the makers is practically useless. Before the war Germany had a monopoly in making these jerry-built tools, and possibly hoped that all the Subsidy-type machines that would be used by the War Office when war broke out would be equipped with them.

The best thing to do with these German sets is to give them to one's deadliest enemy, and buy a new set of sound British-built tools from one or other of the well-known accessory houses. The shifting spanner is an abomination, for, being always loose on the nut, it slips round and takes off the sharp edges, so that a good grip cannot be obtained. The next step on the downward path with that particular nut is to take a pair of dogs or pliers to it; and after that the trouble really begins!

The ideal car would have only two, or at most three, different sized nuts and bolts used throughout its construction. Unfortunately we have not yet reached this happy state of affairs. Among the tools carried on the car itself on the road should be any special appliance contrived by the maker for use on any part of the engine or chassis. One may easily spend hours in unscrewing some awkwardly placed nut which, with a special spanner, could be taken off in less than a minute.

CHAPTER XI

THE CAR ACCESSORIES THAT SHOULD BE PROVIDED WITH THE CHASSIS

THERE is a wide range of opinion about the accessories that manufacturers should include with their completed cars. Some owners think that every detailed fitting, either of the purely luxurious or the simply useful type, should be supplied with the car. Others, so long as no part essential to the handling of the car is omitted, have no desire for elaboration. The maker must do his best to satisfy everybody with a due regard for commercial considerations and his own pocket.

The car owner, paradoxically enough, often complains about the heavy cost of car fittings when he has to buy and fit them at his own expense, but he has an idea that the same fittings can be had by the maker for practically nothing, or at least for so small a sum that they can be included in the specification of the car without additional charge.

A moment's thought will show how impossible this is. Supposing a maker is trying

to supply a very complete 12 h.p. touring car for £400, on a works output of twenty cars weekly. Probably the bulk of the sales to the public will be made through agents. These will require a discount of 15 per cent., and in many cases, owing to the trade customs, more like 20 per cent. has to be paid.

The maker, then, receives on the higher figure, £320, and out of this his own advertising expenses, profits, and other outgoings, apart from the sheer cost of building the cars themselves, must come. It will be seen that the working margin is quite small—certainly there is not the £100 profit per car that many people think. Although the cost per unit is low, when buying electric-lighting and engine-starting sets, for example, for such a car, in big quantities, it still amounts to some number of pounds. To this must be added the cost of fitting, and the maker must increase the selling price of the cars by so much, or work on an insufficient profit.

Where the margin is too fine, and the maker will not increase selling prices, he is often enough accused of not giving value, those who criticise overlooking the rather obvious fact that they have the remedy in their own hands.

Always there must be consideration on the part of the buyer. If it be his hope to buy a completely equipped touring car for £300 he must not expect every accessory that ingenious

accessory makers have brought out to be included in the first cost of the car. On the other hand, if the price of the car be £500 to £1,500, buyers are more justified in expecting to be rather more generously treated in the matter of detail fittings.

Before the war there was no set rule. Some car makers did not even include tires in their chassis prices, and others made a claim of including as accessories and detailed equipment articles that were actually nothing of the sort. For example, a screen can now hardly be termed an accessory; rather it is a part of the standard body equipment; certainly not one buyer in a thousand would buy any car that was not fitted with a screen, unless, of course, there was a reasonable reduction in the price because of the omission. The explanation is that on their first introduction some accessories are luxuries, but after a while they are generally adopted and become necessities without which no car is complete.

Broadly it would not be a bad definition to say that under the heading of complete equipment the car maker should include every fitting making for actual driving comfort and compliance with the law, and, in addition, all tools and fittings needed to make any reasonable running repair on the road. A screen, as said, is indispensable, and a waterproof hood and side-curtains come under the same heading.

Because of the law in regard to speed a reliable speedometer should also be a standard fitting. This should be built into the chassis, just as the electric-lighting set is built in. If the drive can be taken from the gear-box or some other part of the transmission where the gears can be automatically lubricated, so much the better. The point is that the speedometer drive and the instrument itself should not be hung on to any convenient part as a kind of afterthought.

In modern cars the engine lubrication systems are both positive and simple, but it would be much better, no matter how good the design may be, if makers were to include some simple lubrication tell-tale oil indicator on the dash-board: far-seeing makers would, indeed, be justified in meeting the cost of this fitting themselves and regarding it as a sort of insurance policy.

Quite obviously a complete tool-kit of good and reliable make should be included with the car, and this should include every special tool which peculiarity in design calls for. The cheap German-made kits that were often included in cars before the war were worse than useless, for it was impossible to work with them and, quite obviously, they must have cost something, even if that something were ridiculously small, but for very little more it would have been possible to supply a well-made

English set. It should be remembered that nowadays many motorists have no mechanical instinct at all. These are apt to think that the maker of the car is also responsible for the tools supplied with it, and if they be of poor quality the maker is blamed.

Some form of detachable wheel or demountable rim has come to be a necessity. Either maker or buyer may have a preference for one type or another, but, so long as good English stuff is supplied, it really makes very little difference which type of wheel fitting is included. In any case provision should be made for the carrying of at least one spare cover and inner tube, so that, unless the driver likes working under such conditions, there is no need—unless the Fates be particularly unkind—for tire repairs to be carried out by the roadside.

On heavy cars two spare covers and tubes should be carried—indeed in America, on the big and costly machines, provision is made for carrying three such spares—but on the average machine one spare will suffice for ordinary running, and a second specially taken in case of extended touring.

The question of electric-lighting and engine-starting sets has already been discussed in the chapter under that heading, and here no further reference is needed beyond a general ruling that the matter of the car's selling price must have a lot to do with the matter. Over

12–16 h.p., and selling at more than £400, both fittings are essential; under the power and price mentioned they are more desirable than essential.

A light quick-acting and powerful jack, specially selected for the car it is to be used with, should be included with the standard equipment. In the past cases have not been unknown where the jack provided has either been too big to go under the axle of the car, or else has been too small to give a sufficient lift.

Lately some very clever inventions in jacks have been made. These are incorporated in the chassis, and are operated by the engine so that, by the turning of a switch, the jacks are placed in position and the car hoisted clear of the ground in under a minute. An elaboration of this new jacking system lifts all four wheels off the ground just as easily and quickly. The cost of these appliances is, however, at present against them in all but the biggest and most expensive of cars.

A good pump is necessary. The modern tendency is towards the powerful foot-operated pump, by means of which the biggest tire can be fully inflated in a few minutes with a minimum of physical exertion. Many of the old-fashioned barrel-pumps were so unsatisfactory that motorists preferred to drive with the tires only half inflated—at a heavy cost to

themselves in tire bills—rather than to struggle with the implements.

The threaded metal connection at the end of the flexible tubing wherewith the pump was joined to the valve of the tire is now being displaced by a very simple and efficient device which has simply to be pushed over the valve, and which is as simply detached when the tire is inflated.

Obviously a full set of lamps is needed, no matter what system of lighting is provided. Number plates should also be fitted by the maker. On or under the running boards adequate tool-boxes, specially designed to hold all the tools conveniently to hand, should be installed.

The maker should provide also a suitable grease-gun wherewith semi-solid lubricant can be supplied to the various components in need of it, and along with the grease-gun should go an adequate oil-can of sound construction—special provision, preferably under the bonnet, should also be made for the housing of this—and also a petrol squirt.

Last, but by no means least—which is a very hackneyed and overworked saying, but one that fits the case well here—a simple and very completely illustrated book of directions, giving the whole lay-out of the engine and chassis, and showing the way to use any special tools, should be provided.

A large-sized chart, diagrammatic, and on untearable linen, should show the whole of the chassis lubrication system, and say when the lubrication to the various parts should be carried out. Another chart should be provided in connection with the electric equipment. Both charts should be hung on the garage wall.

CHAPTER XII

THE FEMININE DRIVER AND HER CAR

FOR long years the humorously inclined have suggested that all the average man has had to do with the buying of a new car has been to sign the cheque. The suggestion has even been carried further in the remark that a well-appointed, prettily painted machine is more easily sold to a woman, even though the mechanical construction be far from satisfactory, than a good chassis under a badly finished body. Here is one of those dangerous half-truths we are told to beware of.

Cars, to an extent, are like houses, and a woman has the most practical eye for both. It is part of her job to see that the maximum of comfort is attained for the minimum of expenditure in each case: and, so far as cars are concerned, even the best of chassis cannot give all round satisfaction if it be fitted with an unsatisfactory body.

Logically enough, though perhaps a year or so too soon, the woman assumes that it is an obligation on the part of the car manu-

facturer to supply a sound mechanical construction. Over this she has little or no control, but in regard to the coachwork she has some say in the matter. Other mechanical affairs in everyday life, she argues, are now taken for granted. Sewing-machines, for example.

Without any mechanical experience or knowledge whatsoever the average woman expects a sewing-machine to stand up for many years, and a car, obviously, should do the same. Perhaps we have not yet reached this happy stage in motor-car construction; but we are not so very far from it, and without undue optimism one is reasonably safe in saying that so long as the chassis bears a well-known name the soundness of its construction may be taken for granted. This being so, then, it is the woman's duty to see that the coachwork, its finish and general convenience and comfort, are all that can be desired.

There is, of course, no ideal car for the feminine driver. Conversely and paradoxically enough there are a dozen, a hundred. Everything depends on particular needs. Most women, no doubt, would like for their own personal use a delightful little coupé, upholstered in a special colour scheme, deeply cushioned, finished with interior fittings of ivory or silver, with electric-lighting and an engine-starter, and a heating system for use in cold weather.

A car of this kind can be converted into an open car for the summer, and a woman may shop with it by herself, take a friend, or, at a pinch, two friends, and some amount of luggage. It is fit for touring or simply driving to the shops or the station, or for visiting purposes. Its lightness makes it particularly a woman's car for driving in traffic; it has a reserve of power for speed or hill-climbing; and it is quite economical in petrol, oil and tires.

Obviously, detachable wheels are essential, and a spare, with a cover and tube already inflated, carried. In case of tire trouble on the road a change can be made with the minimum of inconvenience, and repairs to the damaged tube made with greater ease in the home garage.

The cost of such a car varies. One may buy a suitable chassis of 10 h.p., fitted with electric-lighting set and engine-starter, for £300--£375, and a £100 or even more may be paid for the body. On the other hand a complete car, hardly so well finished in detail, may be had for £300 £350.

Ideas change, and the war has speeded us up in many ways. For example, in 1914 a woman driving a touring car was not a very common sight on the roads. Now a woman may drive any sort of motor vehicle, from a solo motor-cycle to a motor delivery van or a 45 h.p. limousine, without attracting attention,

unless, of course, she handles the car so badly as to be a common danger! There is no sovereign remedy for the fool driver of either sex, but fortunately these are very few indeed.

The family woman may now legitimately take more interest in the family car than she did before, because she will most probably drive it more herself. She may take her husband and visitors to and from the station, the youngsters to school, her friends and herself out shopping and visiting during the day, and surrender the wheel to her husband for the longer drives of the week-end very gladly. It is, of course, her own particular business to see that that gentleman does not find undue fault with the condition of the car when she hands it over to him!

Assume the vehicle in question to be a five-seated machine with an open touring body, horse-power about 12–16, what changes are necessary as compared with the car bought by paterfamilias in the old days for the use of the family, but to be driven either by himself or a paid chauffeur?

First of all there is protection from the weather to be considered. The screen must be double and fitted with a positive quick-locking device, so that it can be set at any desired angle to suit particular conditions. Then the hood must be in the full sense of the word a "one-man-hood"—or in this case a

"one-woman-hood." So far the term has been a misnomer in many instances, for many hoods have needed the combined efforts of two people to put them either up or down.

The side-curtains should fit closely and have ample-sized fastenings that are not burred over or pulled out after a week or two of use. They should be fitted with good-sized windows, and should open outwards with the doors.

Very obviously some provision should be made for the different reach of leg and arm in driving. What makes for comfort with an average-sized driver would make an unusually tall person very uncomfortable and cramped, and might even be dangerous for a person shorter than the usual. It is not at all difficult to allow for this changing about of drivers.

Either the driving seat itself can be made adjustable sliding in a runway either towards or from the steering wheel, and being securely locked by one movement of a lever or the respective pedals to accelerator, brake, and clutch can be made adjustable, at the option of the manufacturers. If both sliding seat and adjustable pedals be provided it would be a person very much out of the ordinary who could not be provided with the maximum of comfort when handling the car.

If the car is to be driven exclusively by a woman some slight departure from the standard fittings is permissible; indeed one would think

that even in these days of a "one-model" policy it would pay the makers to equip some few of their machines specially for the woman owner. There can be considerable difference of opinion about the wisdom of providing mechanical accessories having to do with the running of the car itself.

Some there are who would urge that, not having a trained ear for mechanical sounds, the car's working should be shown as nearly as possible on the dashboard, so that her eye would warn the driver in case of imminent trouble. Others say that the average woman is no worse than the average man in this matter of a mechanical sense, and that to load up the dash with indicators and gadgets of many kinds would simply mean additional expense, add to the complication of the car itself, and either scare the driver into extreme and uncomfortable nervousness or render her quite oblivious of the existence of the fittings and their functioning.

As in most cases the balance of informed opinion inclines towards extreme simplicity, it is the business of the car manufacturer to build cars that, with reasonable attention to lubrication and driving, will go on running for tens of thousands of miles without failure; and if the maker does what is expected of him in this respect there is no need to complicate matters; any tendency towards undue wear

will either make itself known to any intelligence, mechanical or otherwise, or will be detected in the course of the annual inspection and overhaul which is the birthright of every self-respecting car.

The dashboard of the touring car for the woman driver should carry simply a trustworthy speedometer, a clock, a volt and ammeter combined with the switchboard for the electric-lighting, and an indicator gauge for the engine lubrication. If the owner care to embellish the dash with a flower vase, that is her own affair.

For the purely feminine car, however, special attention should be paid to the matter of detailed fittings. For example, it is the business of the coachbuilder to provide some accommodation for the shopping and visiting list, the library book, the companion containing mirror, brush, etc.; and it is undoubtedly a convenience to a woman driver to have a small rack or locker somewhere round about the driving seat for the reception of small parcels.

Incidentally, the woman owner-driver has need of more attention in the matter of accommodation for hat-boxes and travelling gear generally. An ample-sized luggage carrier should therefore form part of the standard fittings of the car. One of the most appreciated fittings on the open touring car is a small window in the screen for use in fog and bad

weather generally. Failing this, some form of screen clearer, which can be operated without leaving the driving seat, is a necessity.

It is rarely that a woman will own and drive for herself a car heavier than those referred to. A big car, no matter who owns it, has generally need of a chauffeur, if only for washing, cleaning, and tire-changing.

CHAPTER XIII

A CHAPTER ABOUT TIRES AND DETACHABLE WHEELS

ONCE upon a time there was a monthly review of travel called *The Car Magazine.* It was born in 1903, and was founded and edited by the Hon. John Scott Montagu, who is now Lord Montagu of Beaulieu, C.S.I., and one of the best friends that the motor-car has ever had. Sixteen years later the spirit of the journal still lives in *The Car and Aviation*, which was also founded and edited by Lord Montagu, in whose editorial footsteps the present writer unworthily follows.

The fact is simply mentioned in order that the quotation which follows may be interpreted in the right spirit. Every man who dares a prophecy or even a direct expression of opinion runs a risk of being proved wrong with the passing of time. Even now there is talk of the invention of the really successful unpuncturable pneumatic tire and, for all one knows to the contrary, this chapter may be in

need of revision almost before the book is in the hands of its readers.

A contributor in *The Car Magazine* once wrote an article called "How to keep a car for £20 per annum." The author pointed out that the greatest enemy of economy in cars was the pneumatic tire, and lamented the fact that no enterprising maker would build a light car at a moderate selling cost and fit it with solid tires. The writer says: ". . . the moderate priced vehicle on the all-conquering pneumatics which we practically are forced to accept whether we desire them or not."

And farther on in his article the contributor says: "It is quite futile to consider the possibility of running a four-seated vehicle on pneumatic tires cheaply. I have done it, and many others have done it also on solids, but as far as I know the four-seated cheap car with solid tires, good and sensible vehicle though it be, is 'off' for the present."

The idea at the back of the writer's mind was that the pneumatic tire was suitable for very light machines like bicycles and the low-powered two-seated cars, but it was too costly, both to buy and to maintain, for the heavier cars. Possibly there was a lot of truth in the contention sixteen years ago, and though the reasoning was not altogether right at that time it was not so wrong as to be absolute nonsense even now.

Much progress has been made in the manufacture of tires, both solid and pneumatic, but if owners are not prepared to give just reasonable attention to the tires of their cars they are going to find them an expensive luxury whether the vehicle be a cheap light car or a luxurious limousine.

During the war the cost of tires increased very little, and in 1919, as compared with 1915, the average cover was about 25–30 per cent. more. Of course the supply of rubber is rapidly increasing as the plantations put in hand during the rubber boom and afterwards begin to bear, and, on the supply-and-demand law, the cost of rubber will fall.

Whether this will off-set the higher wages and taxes that have now to be paid or not it is too soon to say, and on the whole, perhaps, it would be wiser to accept the fact that tires are and will remain dearer than they were before the war. Therefore it behoves every one with an eye to economy not to consider the time spent in looking over the tires as wasted. It has, indeed, a way of translating itself, favourably or otherwise, into £ *s. d.*

In the first place no tire should ever be placed on a rough or rusted rim, or one that is dented along the beading. Rust is a deadly enemy of rubber and canvas, and many a cover with thousands of miles of running left in its tread has had to be scrapped simply because a

rusted rim has eaten right into the tire's foundation, and rotted it until the walls of the cover pulled away from the beading.

It is not at all a bad idea, even if no trouble has been experienced, to change the tires about on the wheels as the treads begin to wear. This, in the ordinary way, will be after a few thousand miles of running - dependent on the weight of the car and the speed at which it is generally driven. While the covers are off it is an easy matter to examine the rims for rust which, if it is present and it will be can be the more easily removed because it is not of long standing.

A shaped stick and a sheet of medium emery cloth are the best tools to use in getting rid of the rust. Afterwards the whole of the inside of the rim should be given a coat of hard-drying enamel. Liquid graphite or ordinary stove polish will serve equally well. An important point to remember, however, is that it is no use putting on the enamel over rust, grease, or dirt. The surfaces to be treated must be absolutely clean, or no good will result.

If the edge of the rim be dented or cut, the whole wheel, unless the rim be of the detachable type, should be sent to the garage to be trued up. This is a simple enough operation, but the necessary appliances are not found in the usual private garage. Often the enamel

is taken from the edge of the rim by the levers used in putting on or taking off covers. The chipped places should be rubbed down with emery cloth and re-enamelled.

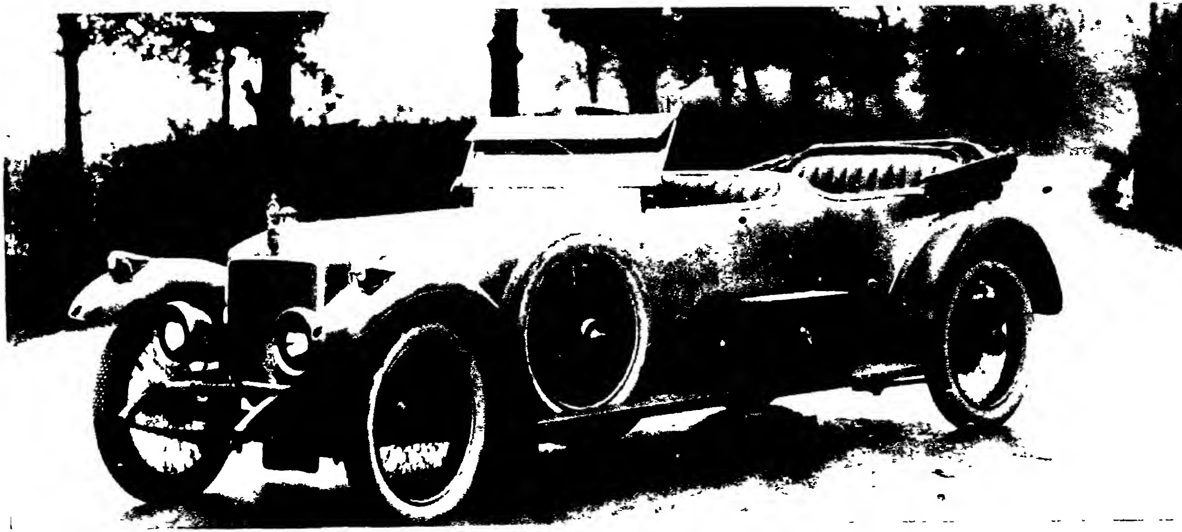
The idea of this present book is to talk about the new motoring, and it is not intended to serve as a text-book of motor-car workshop practice. Those enthusiastic owners who wish to be versed in every hint and device useful to them in actually fitting tires and covers should not fail regularly to study the pages of the weekly technical journals, such as *The Autocar* and *The Motor* and their allied publications dealing with motor-cycles and light cars. Each of these journals also publishes a practical text book which is thoroughly to be recommended. One understands, also, that a further edition of Lord Montagu's *The Montagu Book of Motoring* is to be published this year.

There is one most important matter, however, that should on no account be overlooked by those motorists anxious to study economy. It is that the tires be inflated to the pressure advised by the maker. There are two quite human objections to this course: one is that with the average hand-operated pump, which is a nasty and inefficient affair of cheap brass and leaking washers, makes it almost impossible, without something like superhuman effort, to work up to the set pressure: and

the other is that a well-inflated tire causes the car to bounce more when travelling at high speeds on rough surfaced roads.

As to the first the trouble is easily and cheaply overcome by buying and using one of the excellent foot-pumps which are made and sold by some of the tire companies. The Wood-Milne, perhaps, is the best known. It used to cost about £2, but now the price is more like £2 10*s*. If it were twice as much it would be a most excellent investment. With its aid the biggest tire can be pumped up from flat without excessive exertion in a few minutes; and, indeed, were it necessary to do so the pump is capable of producing pressures far in excess of what any tire can reasonably be expected to withstand. The Dunlop people also sell a most excellent foot-pump. Both the appliances are light and compact and occupy very little room on a car.

There is some difference of opinion as to the respective merits of detachable rims and wheels. Each has its advantages and disadvantages. The complete spare wheel weighs quite a lot, and provision for housing it somewhere on the car must be made. If two wheels are carried the problem is complicated by so much; yet two wheels are really necessary if trouble on the road is to be avoided on long-distance touring. Again, the complete wheel is more expensive than the simple rim. Against this



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must be set the fact that the complete wheel is more readily shipped and dismounted.

In both cases the covers must be mounted and inflated in the garage, and carried on the car ready to be slipped into place without delay. One does not avoid punctures and bursts by carrying spare wheels or rims—one simply makes the repairing more convenient. The detachable rim is lighter, of course, and two or three rims weigh no more than one complete wheel. With a little ingenuity the interior space can be utilised for storing other articles.

On the other hand, simple as the device is, it certainly takes more fitting than does the detachable wheel. Circumstance and individual preference must, it seems, be left to settle the problem unless some improvement is brought about which will settle the vexed question beyond dispute.

If the car be a big one with ample room for spares, and with first cost not the main consideration, perhaps the detachable wheel has most advantages. Where both space and money are limited, however, there is a great deal to be said in favour of the detachable rim, which has the additional advantage that if it be of the contractile type it is a simple matter to get the cover into position without the use of levers. With the wheel, of course, the cover has to be forced over the rim in the usual way.

It is a pity that vulcanising is not more popular. Those car owners who have once had tires vulcanised can never understand why so many people are prepared to put up with the old-fashioned and inefficient repairing methods. There is practically no accident that can happen to a tire on the road, beyond that of fire, which cannot be made good with a vulcaniser and a skilled operator.

A valve pulled out of its tube can be replaced and the tube made equal to new. A burst of up to a foot in length can be patched and made as though it never existed. Covers cut almost to shreds with broken glass can be renovated, and the damage made good in the event of that disastrous happening when a sharp nail or flint works its way in between cover and tube and plays havoc before a burst comes.

The ordinary owner, of course, cannot reasonably hope to become a skilled vulcaniser without tuition and practice. By following simple instructions, however, it is possible, with a modern outfit, to do all straightforward repairs at the first trial. The simplest jobs, such as filling up a gash in an outer cover, can be done without removing the tire or even deflating it; the vulcanising outfit can be strapped into position on the cover itself. Nor is the outfit expensive. A satisfactory portable vulcaniser capable of dealing with all ordinary work and which can be carried on the car,

together with a supply of material, can be had for a five-pound note.

The manufacturers always state what size tires should be used with their cars. In nine cases out of ten the buyer will be well advised to fit a size larger. The extra cost is more than made up by the increased comfort in running, the longer life of the chassis, and the extra mileage the bigger tires will cover in the ordinary course of events.

It is as well, also, to pay some attention to the type of tire used. In the summer, for example, for ordinary touring in England, plain treads all round, or rubber non-skids, can conveniently and cheaply be used. In wet weather, however, the danger of skidding makes the more expensive steel-studded non-skid tire, on two wheels at least, practically essential.

Light and grease are enemies of rubber. Spare tubes and covers, unless carried *in situ* on spare wheels or rims, should be well wrapped up and stored in a cool, dark place away from the light. It is an economy in the end to have special covers made even for these. High speeds are terribly hard on tires, while under-inflation is another source of expense. Especially with the elliptically shaped covers the walls may collapse when the covers are under-inflated long before the treads are even appreciably worn.

One golden rule of tire economy is never to delay repairs. If a cover be damaged in running change the wheel and have the damaged part vulcanised so soon as opportunity offers. There is a most excellent pressure-gauge to be had which, if motorists would only use it, is one of the best friends they could wish. At the minimum of trouble this gauge can be applied to the valve of the tire, and it indicates plainly the exact air-pressure contained therein. It is known as the Schroder pressure-gauge; its cost is a few shillings; and every motorist should make a point of buying one and using it.

CHAPTER XIV

WHAT SORT OF WHEELS SHOULD BE USED?

GENERALLY, when something new is needed, manufacturers turn to the nearest and cheapest source of supply. So it was with car wheels. Practically all the early cars were fitted with wooden or artillery wheels, the two types being one, so to speak. Twenty years ago there was a sufficiency of wood for all purposes, and if nothing else had intervened, the present price of timber would have forced manufacturers to set about discovering some satisfactory substitute for the wooden wheel.

As a matter of fact other things did intervene, and. apart altogether from the cost of wood, the artillery wheel, even in 1914, had a number of serious rivals, and there were signs that the competition was becoming very much more strenuous.

When car wheels were first wanted there was plenty of wood available for the purpose, there was special machinery in existence for making the wheels out of wood, and there was plenty

of skilled labour to hand. Therefore the wooden wheel got a big start. It was not long however, before its disadvantages became apparent. In hot weather the spokes tended to shrink in the wheel felloe, and there was danger of the whole wheel collapsing. Actually the danger from this source was more apparent than real, for in the course of a long experience one has never been confronted with an accident due to this cause.

Warping of the wood could, however, without seriously affecting the strength of the wheel, throw it out of truth to some extent, with the consequence that undue wear on the tire followed. A further disadvantage was that the artillery wheel presented difficulties in cleaning. A hose pipe and a spoke brush, of course, could dispose of most of the mud and dust: but because the spokes were painted and varnished it was necessary to go over each one separately with a leather unless the wheels were allowed to become deplorably shabby in a short space of time.

Now, car owners do not like shabby vehicles, yet they object to spending time and effort in keeping the vehicles clean. Wheel makers, then, were confronted with the task of finding a wheel that was just as strong as the artillery type, that was impervious to climatic changes, that was light in weight, cheap to manufacture, and at the same time that lost nothing

in appearance in comparison with its wooden rival.

A great many experiments were made before satisfaction was obtained. Some of the early disc wheels were dangerously weak and far too heavy. Almost from the beginning there were one or two makers of cars who used the wire-spoked wheel, but these had a long and uphill fight before it was generally recognised that the wire wheel was much stronger and reliable than the artillery wheel.

A great many people also objected to the former as looking too thin and "tinny" for motor-cars. It was excellent for bicycles, they said, but it was not suitable for cars. A trivial reason, of course, and one not based on absolute fact, yet every maker knows to his cost that an unreasoned prejudice on the part of the buying public can kill a splendid invention. On the other hand a sudden and almost unreasoned public liking for some simple invention can and does create an enormous demand.

There are the stories of simple inventions, for example, when fortunate inventors made big fortunes. Did not the man who placed a rubber tip on the end of lead pencils thrive exceedingly? Yet the idea was simply a fad that the public adopted. Who uses rubber-tipped pencils these days?

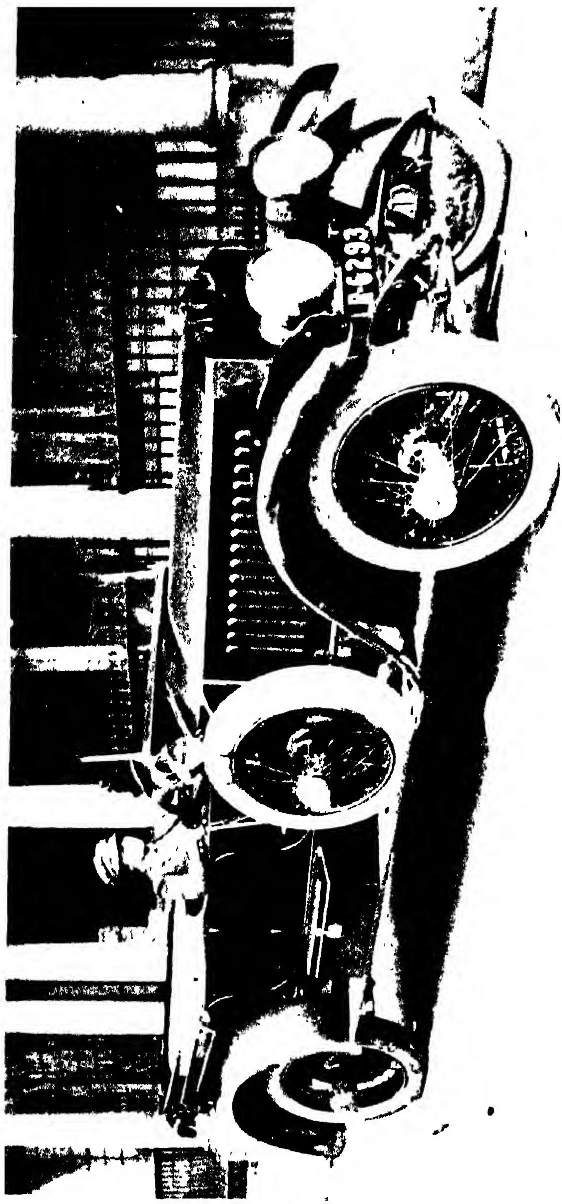
Wire-spoked wheels were improved in various ways from time to time. Then a series of con-

clusive tests proved that they were stronger than the wooden wheels. They stood up to their work in all climates, and age seemed to have no effect on them. Yet they remained more costly.

Fortunately the public eye began to get accustomed to them—perhaps the fact that the makers of expensive cars, who were determined only to use the best materials regardless of expense in their products, had something to do with the case; people, seeing the best cars built by makers with a reputation to think of, fitted with wire wheels, began to regard them more favourably, and the slight extra cost is now very little, if anything, of a handicap. The wheel is, indeed, excellent. It is strong, light, and long-lived, and it can be cleaned with the minimum of exertion.

The first of the disc wheels, as already said, were both weak and heavy; they were also associated for a while with heavy commercial motors and various types of spring wheel. So far as the writer's experience goes there is not yet any satisfactory form of spring wheel. The idea fell into public disfavour for a while; then a compromise was arrived at, chiefly for racing purposes.

The ordinary type of artillery wheel was fitted with an outer disc for the purpose of lessening wind resistance--which it successfully did. But the cone-shaped disc, brought out



to a point in the centre of the wheel, was unsightly. After a while various improvements in construction were made, and now it is possible, and not costly, to fit the wheels of any ordinary car with quite satisfactory discs: discs that look well without, however, affecting accessibility in any way.

In the meantime other manufacturers had stuck to their experimental work, and now there are available all-metal wheels of the disc type that are perfectly satisfactory as regards weight, cost, life, and appearance. This type of wheel is, indeed, growing rapidly in favour. The Americans have coined a very expressive word for these wheels: they call them "Disteels," and although one company has adopted the word for its own products, the title is more of a generic one.

Both in England and on the Continent there are now available excellent steel wheels of the tubular spoke variety. These in most respects are just as satisfactory in operation as the disc type, but to outward appearance they resemble the artillery wheels. They do not require so much polishing, however, for the metal takes paint and varnish better than wood, and a hose and spoke brush in cleaning is all that is necessary. They are light, strong, cheap to manufacture, impervious to climatic change, and long-lived.

Twin wheels are finding some degree of

favour on the heavier and more luxurious cars. They are only fitted to the back-axle, of course, and although they help to cushion road shocks, while the tires give a bigger mileage, it should be remembered that they are much heavier, and that the car needs six covers and tubes in place of four. Whether the extra initial cost is justified can best be discovered by car owners themselves after actual experience. For really heavy work with a big car they are, perhaps, taking all things into consideration, an advantage.

The wire and metal wheels must, however, be considerably cheapened before they can expect to oust the wooden product, especially in countries where there is an abundance of suitable timber for their construction, and also a demand for the cheapest cars. In the ordinary way the wooden wheel will stand up to its work for years: apart from excessive side strains—under which the wooden wheel crumbles up altogether, while the metal constructions only buckle—it will certainly stand up for three to five years.

And the cheapest class of car is not intended by its maker to go on for ever. Give it three to five years of hard work, and then, argues the manufacturer, it is time the machine was scrapped, having earned its cost, and a new one bought. Where these conditions obtain, then, the wooden wheel has a long life before it

unless great improvements are made in the other types. Elsewhere the metal wheels have a better chance.

One is not particularly impressed by the prospects of the spring, elastic, or resilient wheel. So many have been tried and so many have been found wanting. Naturally the problem is by no means an impossible one. Any day some invention may come along that would consign all the present ideas to the scrap heap. Were a really satisfactory spring wheel available there would be no need for pneumatic tires. Conversely, if we had a trustworthy non-puncturable pneumatic tire there would be little need for the spring wheel. Possibly some day we shall have one or the other, or a combination of the two.

There is a third way out of the problem: springing and suspension systems may be so improved that any sort of wheel would be satisfactory provided it were strong enough to stand up under the road shocks while supporting the weight of the car. It would be a great advantage if something of this sort were available. In addition to simplifying motoring it would also cheapen it.

These things, however, are in the future. Nowadays we have our choice: wooden wheels, discs, and metal spoked. All have their own distinctive advantages.

CHAPTER XV

CARBURETTERS: FUELS AND ENGINE-STARTING

UNLESS we can get back to the motor fuel standard of pre-war days, an unlikely occurrence, many well-known makes of carburetter will need to be redesigned. The carburetter's function is to supply the engine with a suitable explosive mixture at all speeds regardless of climatic conditions. No appliance has yet been evolved that does the job, judged from the scientific point of view, efficiently. The engine is starved of fuel at some speeds, and is too richly supplied at others, and at no time nor under any condition is the full efficiency of the fuel obtained.

Scientific engineers are, however, more interested in such obtuse matters than the average car owner, who is quite satisfied if the carburetter supplies the engine with a fairly satisfactory mixture at the rate of between fifteen to forty miles to the gallon. Should some new device double this—why, all the better, thinks the sensible motorist.

The fact is, though, that during the war all

the high-grade motor spirit was taken by the Government, and the stuff left over for civilian use had more the properties of paraffin oil than petrol. It was heavy and oily, and would only vapourise when heated. Under the best conditions it was difficult to supply the engine with a good explosive mixture, and the consequence was the cylinders and pistons carbonised rapidly and the engine had to be cleaned out more frequently.

In order to cope with the poorer fuel many owners reduced the efficiency of the car-cooling system. Some cut the air-fan out of action; others fitted a cover to the radiator to preserve the heat; a very favourite device was to feed the carburetter with hot air, generally supplied by fitting a muff to the exhaust pipe. Thorough people tried a combination of all three, and added other devices of their own invention.

The main idea was to assist vapourisation by applying artificial heat. In pre-war days the higher-grade petrol readily vapourised, being a volatile spirit; an explosive mixture could readily be produced by exposing a quantity of the spirit to the air at a normal temperature in an enclosed space. War spirit, however, was not volatile to anything like the same degree, and considerable artificial heat was needed to vapourise it.

Nowadays motorists are being supplied with improved petrol, but because many other

uses have been found for the spirit, while there are prospects that the natural supply may soon be unequal to the demand—there are other reasons. also—it is doubtful whether, at least for some years, we shall ever get petrol of the old pre-war quality. In consequence carburetters must be redesigned to deal with the heavier and less volatile fuels.

Of course great things are expected from new motor fuels. Alcohol holds out distinct possibilities ; it is to be had from many sources ; there is practically no limit to the supply that can be made available should the demand justify it : possibly it can be more cheaply produced than petrol, and most countries have or could have a native source of supply.

Then there is benzole. Here in England, if our coal were properly treated, we could produce about 100,000,000 gallons of benzole annually. This, roughly, represents about one-half our motor spirit consumption. Coal-gas also is a promising fuel. During the war, and especially in the industrial districts where there was a good supply of coal-gas immediately available, many motor vehicles used the fuel in preference to petrol. It compared most favourably as to cost.

The big gas-bags of rubberised fabric were, of course, unsightly, but these were simply in the nature of preliminary experiment. It is not at all impossible to build light containers

capable of holding gas under great pressure: a battery of these could hold enough gas to carry the average vehicle as far as an average tankful of petrol. By standardising the containers, just as the petrol tins are standardised, motorists would be able, having once bought their equipment, to exchange empty containers for fully charged ones at practically all garages, for the price of very little more than that of the gas contained therein.

There is a prospect, also, that motors may be fitted with individual gas-producers in the future. An experimental vehicle already equipped with such an apparatus has given most gratifying results, and although the appliance was unsightly and occupied too much room, nevertheless it proved trustworthily in operation, and the gas produced was equal in cost to petrol at about 2*d*. per gallon! Further experiment along similar lines should lead to striking improvements.

Indeed, one way and another, there are half a dozen or more ways of running motor vehicles on fuels other than petrol. But the point is that at the moment we have either to use petrol or benzole, these being the only fuels immediately available at a reasonable cost and in adequate quantity.

Some carburetters are water-jacketed in the ordinary construction. After the engine has been running for some time and the water in the

cooling system is heated, the carburetter is also warmed by the water, and therefore vapourisation is assisted; but there is no benefit from the water-jacketed carburetter when the engine is being started from cold.

There are several ways of overcoming the difficulty. The radiator may be drained and refilled with hot water; a charge of volatile spirit may be squirted into the cylinders; the induction pipe may be warmed with rags wrung out in hot water, or by a shaped iron previously heated, or by some electric appliance; the carburetter may be primed and a very rich mixture supplied, or the air-intake may be stopped up either with a rag or a hinged flap.

All these devices, however, with the possible exception of priming the carburetter when special provision for doing this is provided either on the dash or the steering column, are in the nature of tricks or "stunts." Owners nowadays do not want to lift up the engine bonnet and fiddle with the carburetter before the engine can be started: therefore the carburetter makers must redesign their appliances with a view to providing an easy starting mixture even with heavy, non-volatile fuels. Particularly is this necessary when engines are started by mechanical means. The thing sounds paradoxical, possibly, at first glance; actually it is not.

The batteries from whence the electric engine-starting motor takes its current are not of unlimited capacity, and if they are called on to turn over the engine many more times than is actually necessary in order to start it they will quickly become exhausted. They may easily, indeed, be damaged so severely as to necessitate extensive repair. Unfortunately, also, the engine will be harder to start in winter when the weather is normally colder and more night driving is the usual thing; but on night driving the lamps are used, and, taking their current from the same battery as the starter, the battery hardly has a chance to become fully charged.

Probably the best way would be for all carburetters to be fitted with an electric heater which could be switched on for a few minutes whenever a dead-cold engine is to be started. This, however, is hardly the carburetter maker's work. The first cost is also a factor against its general adoption for any but the expensive cars. As an alternative very rich starting mixtures would be best.

If this cannot be automatically arranged in the carburetter design there should be some easy adjustment convenient to the driver's hand, but attention should be given to ensuring that the carburetter setting returns to normal when the start has been effected and the engine warmed up. The car manufacturers should

also remember that poorer fuels will be used in the future, and in consequence they should provide their vehicles with an adjustable cooling system, either by way of providing the radiators with louvres, by throwing the fan out of action or reducing its efficiency; a "hot-spot" in the induction pipe is also worthy of the car maker's attention.

In justice to the carburetter makers it must be said that, even when using the poor quality war spirit the writer had no trouble in starting cold engines even in the coldest weather, at the cost of some little attention and trouble, coupled with a little extravagance in petrol consumption. The average car owner, however, as already said, has no liking for "fiddling" with his car; he wants a machine that is, in effect, automatic.

Ordinarily the carburetter setting should only be altered by a qualified man, for the amateur has neither the patience nor the experience to improve matters. It is not always a question of fuel consumption or power. A great many things must be considered. There should be plenty of power at low speeds, for example, without undue fuel extravagance on high. Again, a very low consumption may be obtained providing that hill-climbing power is sacrificed.

The expert, knowing the carburetter with which he is dealing, may with advantage

change the setting several times a year to suit varying climatic conditions, but the ordinary owner had best be content with a good average setting, which is best selected by the makers of car and carburetter in conference, which makes up its loss on the swings, so to speak, with its gains on the roundabouts.

The enterprising car manufacturer will, if he finds it impossible to obtain any carburetter especially suited to any particular engine from the easy-starting point of view, fit one or other of the simple devices for helping in this respect, of which there are now several on the market. There is a small auxiliary tank, for example, which is mounted somewhere on the dash, and which contains a pint or so of high-grade fuel. A small plunger-pump is geared up to the tank, and a depression of the plunger sends a charge of petrol-saturated air along a small pipe directly into the intake manifold. This is a simple, positive, and inexpensive appliance which can readily be fitted to practically any car.

Prior to 1914 there were only two systems of petrol feed employed to any extent on English cars. The simplest was the gravity-feed, which demanded that the tank be housed well above the carburetter. For ordinary travelling there was little fault to be found with the system, providing tank and carburetter were intelligently located. At high speeds, how-

ever, either on the level or when hill climbing, there was a danger of the carburetter being starved of fuel.

The pressure-feed system was more generally used on the more expensive cars. When in working order it was more positive in action, but its extra complication increases the possibility of trouble. An auxiliary hand-pump is provided in order to work up an initial pressure in the petrol tank: afterwards the pressure is maintained by mechanical means. There is a further advantage in this system in that the petrol tank can be of greater capacity, and it can be housed out of the way to the rear of the car.

Of late years the Americans have been giving great thought to what is known as the vacuum-feed system which has now come into great popularity with the American makers. Briefly it is a combination of the gravity- and the pressure-feed systems. As with the latter the main tank can be carried at the back of the chassis. By air pressure the petrol is forced to an auxiliary tank housed on the inner side of the dash and well above the carburetter. From this second tank the feed is by gravity; the whole action, of course, being automatic and calling for no attention on the driver's part.

This system is becoming increasingly popular in this country, and some of the post-war cars will be fitted with it. One of the best known

of the English carburetter and accessory makers has made a number of improvements, and possibly, if his hopes materialise, the vacuum-feed system may even oust the others before long.

CHAPTER XVI

POPPET-VALVED, SLIDING-SLEEVE, AND RADIAL ENGINES

THE ordinary motorist is still concerned in his mind as to the relative merits of the rival engines. The critics of the older type of poppet-valve tell him that the engine is noisy and inefficient, while the other side maintains that it is impossible to make a good job of the sliding-sleeve engine in practice, however good the idea may be in theory. The joke is, of course, that there are tens of thousands of both types now in service and giving every satisfaction. Somewhat one is reminded of the early Gnome aero engines, which, according to all the accepted rules and regulations, should not have functioned at all.

Without entering into any scientific discussion we may here outline the main arguments both for and against the various types of engine. After that, with some knowledge of the actual car or cars the prospective buyer may have in view, he must pay his money and take his choice. The poppet-valved engine,

badly made and of unsuitable materials, can be an atrocious production. Only one engine can be worse—the sleeve-valved unit! As a matter of fact, however, every maker with anything of a reputation to consider is now making an excellent engine without regard to the type.

The poppet-valve can be noisy, and after a little wear it can become noisier still, while with the increase in noise goes a decrease in efficiency. Badly designed passages for the gases are very easily achieved by the designer who has not made a special study of his subject. The poppet-valves are held on their seats by a comparatively strong coil spring. They are opened against the compression of the spring. either direct through a cam-operated tappet or through a push-rod and a rocker arm, also cam-operated. The latter, generally, when the valves are of the overhead type and located in the head of the combustion chamber.

The cams are at first very carefully shaped to open the valve just the right amount and at the right times; also, by very accurate fitting up, play between the tappets and their guides is reduced to a minimum. Further, the space between the tappets and the valve stems is very nicely adjusted to allow for expansion through heat. The consequence is that the cam has a rolling action against the tappet, the latter works smoothly in its guide, the valve

slips sweetly in its guide in turn, and the valve is opened at exactly the right moment and almost noiselessly. Naturally, as the spring forces the valve back to its seat, there is a slight click, while there is a further tapping noise as the tappet comes in contact with the valve stem on the up-stroke.

As wear takes place these noises become louder; the cams tend to lose their shape, so the valve itself is not accurately operated; both tappets and valve guides wear and set up noises of their own, and although in modern engines every possible means of adjustment is provided, it is almost impossible to keep an old engine in exact tune. As the cams wear the accuracy of the valve operation is impaired, with the consequence that either power falls off or there is an undue fuel consumption.

The overhead type of valve makes possible a better mechanical job, for detailed reasons which would need too much space for discussion here. Some time ago there were two serious objections to this type of valve gear, although it was generally admitted to be more efficient. One was the danger of the valves breaking and leading to a smash owing to the fractured head falling into the cylinder and coming in contact with the swift-travelling piston, and the other was connected with lubrication difficulties. The first objection has been overcome by the use of steels so strong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that breakage is humanly inconceivable, while the experience engineers have gained during the war with aeroplane engines has made it possible to overcome the second quite successfully.

Poppet-valved engines needed for high-speed work, such as racing or flying, are sometimes fitted with two inlet and either two or three exhaust valves per cylinder. This, of course, leads to a more complicated valve gear and increases the chances of trouble; at the same time it makes possible a vastly more efficient and powerful engine with small increase in weight. For ordinary touring-car purposes, however, the regulation valve allowance per cylinder will be one inlet and one exhaust for some years to come. Incidentally, the overhead-valved engine has certain advantages in the way of cooling and ignition.

Fouling of the engine is, however, a big drawback of this type—that is, the poppet-valved unit generally. Even with almost perfect combustion conditions the gases are not all burned, and, in consequence, carbon is deposited on the piston head and in the combustion chamber generally. If all the surfaces can be machined, so much the better, for the smoother the surface the less likely is carbon to be deposited on it.

It is for this reason, as much as any other, that the detachable cylinder head, which allows practically the whole of the combustion cham-

bers to be machined, is coming into favour with car manufacturers. Further, the flaming gases generated by the explosion, and swept to a high velocity by the movement of the piston, burn and pit the valve surfaces, and in time affect the gas-tightness of the joint when the valve is seated.

Because of this every few thousand miles the poppet-valved engine must be taken down for the purpose of cleaning out the carbon deposit and regrinding the valve surfaces. If this be not done many troubles follow. The carbon in the combustion chamber glows at a white heat and leads to pre-ignition and overheating, which results in an abnormal fuel consumption and a falling off in power. The leaking valves fail to hold compression, and so the full power of the explosion is lost.

The troubles are accentuated the longer the engine is run; and as this depositing of carbon and pitting of valve surfaces takes place, so wear occurs in the guides, on the tappet surfaces, and on the cams; and in effect it may be said that the efficiency of the poppet-valved engine falls off progressively practically from its first hour of running.

As already remarked, however, by fairly constant cleaning and adjustment the unit can be maintained in reasonably good condition. There is also an easy process whereby the carbon can be cleaned out, by burning it away

without need to take down the cylinders. There are some slight disadvantages attached to this method, but they are not very serious. So much for the poppet-valved engine.

As to the sliding-sleeve type of engine, which is, although academic critics deny it, a sort of own brother to the sleeve-valved unit, here the tappet-operated valves are dispensed with, and their place is taken by a sleeve or sleeves which slide one inside the other or the cylinder, and which are concentric with the cylinder itself. In the sleeves are ports which register at the required moment and through which the explosive mixture is led into the combustion chamber and the exhaust gases expelled. There are various modifications of the sleeves and valves, but the general principle is the same.

It is urged against this type of unit that too much power is needed to operate the sliding sleeves, and that it is practically impossible to work to the microscopic accuracy essential if the idea is to be really successful, while the strenuous conditions under which the sleeves must work are such that if the necessary accuracy is attained it cannot long be maintained. The heat, it is said, must warp the sleeves, while if allowance for this be made, the efficiency of the engine must suffer; further, it is next to impossible properly and adequately to lubricate the sleeves under the conditions in which they must ordinarily work.

There are positive advantages, however, which even the most biased critic of the sleeve-valved engine must grant it. First of all comes almost absolute silence in operation. Sliding one inside the other, and positively driven, there is no clicking of tappets nor slapping of valves on to their seats.

It is a comparatively simple matter to cool the whole of the combustion head equally, while practically the whole of the working parts *in the cylinder, including the* combustion chamber, can be machined, even to a polished finish if necessary. The sparkling plug can be located anywhere in the cylinder head--the exact centre being usually selected for various reasons—to ignite the mixture in the most advantageous way.

Further, carbon deposit is not nearly so serious a matter, for as a matter of fact it tends to settle where it is out of harm's way, and even where it can do more good than harm. Actually a slight deposit is rather an advantage than otherwise in a sliding-sleeved engine, because it seals any leaks that may occur in connection with the sleeves themselves. As to lubrication, well, it must be admitted that the trouble is overcome by using a little more oil than would be used with a poppet-valved engine of the same power ; while as to rapid wear and tear of the sleeves charged against the unit by some of its critics, the fact remains that slight

wear is compensated for by the carbon deposit, so that it is unaccompanied by any loss in efficiency.

The fact that the engine has been used by some of the most famous makers for many years now shows that it is a practical success in every-day use, and the further fact that it has been successfully subjected to the most severe tests to which any engine could possibly be put shows that in comparison on special work and in economy it is not in need of any concessions. To a certain degree it may be said that the sleeve-valved unit increases its efficiency from the first hour of its running. Certainly its ability to go on running for many thousands of miles without need of overhaul and adjustment is an outstanding advantage in the eyes of many owners.

What the thing boils itself down to is that the poppet-valved unit can be made slightly more powerful for a while at the price of extra noise and a great deal of careful attention, while its rival can be extraordinarily silent in operation and long-lived, the sleeve-valved unit, taking all things into consideration, is throughout its life the more consistent performer.

Mechanically it is a much easier business to build a good poppet engine, and it was poor workmanship that helped to get the other unit a bad name in the early days. The sleeve type

needs such excellent workmanship, machine-shop organisation, and material if it is to be a success, that not every maker dares tackle the job—which explains why the majority of makers still adhere to the older type of engine.

The radial engine is, for all practical purposes, a war product. There had previously been experimental units of the type, but no established car builder had committed himself to them definitely. During the war the radial engines for aeroplanes were a distinct success, however, and those motor-car engineers who at the Government request gave their attention to aircraft work very naturally had an idea of using the experience gained with light high-powered engines to account on their return to purely commercial work.

The radial engine must not be confused with the rotary, though at first glance it has much in common to outward seeming. In the latter the cylinders revolve round a fixed centre, cooling themselves by their passage through the air.

The type is not particularly suited to car work. The radial engine has fixed cylinders, set star fashion around the base chamber. The single throw crank-shaft, to which all the connecting-rods are geared, rotates and has keyed to it a flywheel in the orthodox car manner. An engine of this type lends itself very readily to

air-cooling, which is an advantage both in manufacturing and in use. Soon after the first announcement was made that an established manufacturer intended to build a light car fitted with an engine of the sort it was also announced that an improved method of casting aluminium cooling fins into the cast-iron of the cylinder casting had been discovered.

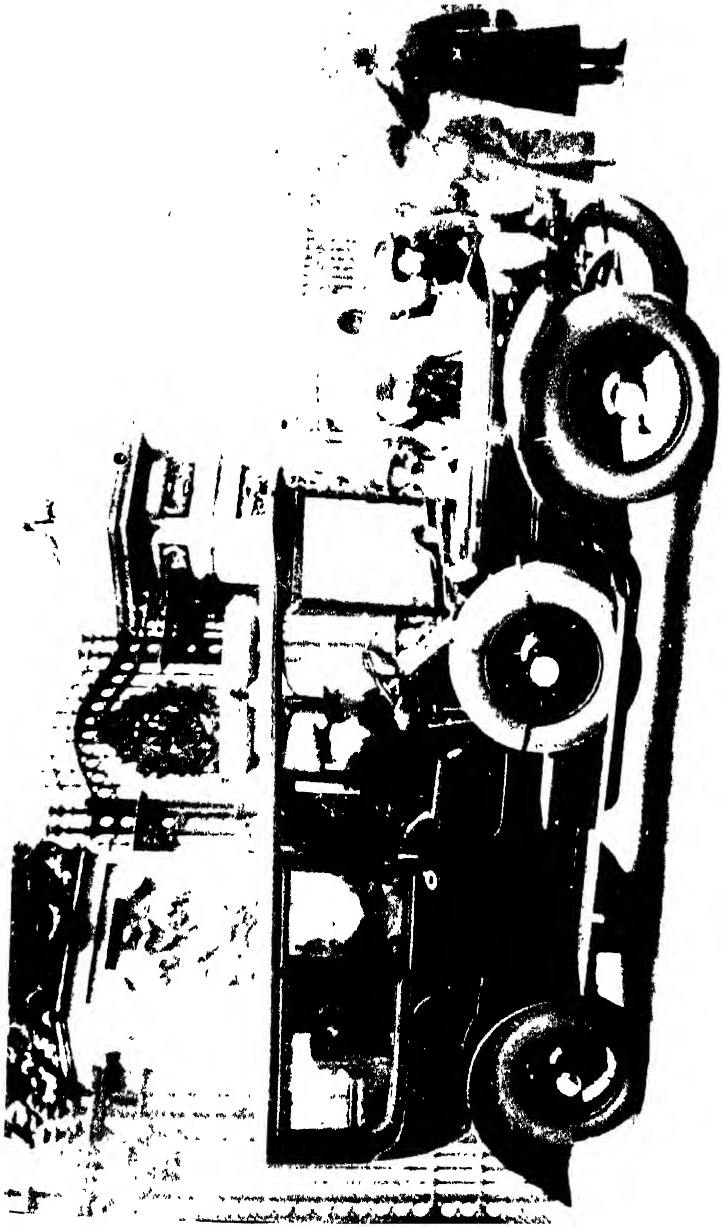
The conductivity, or heat transmission properties, of the lighter metal is about ten times that of cast-iron at a temperature of 600 degrees Fahr.; so there should be no difficulty about the cooling of the unit. Very strenuous tests have shown the method to be a marked success, and incidentally the experiment may even lead to the ordinary upright type of car engine being air-cooled. The greatest problem in air-cooling is to ensure that the back of the cylinders is equally cooled with the front, otherwise distortion follows. Generally the trouble is overcome by providing special air-jackets all round the cylinders, through which air is either forced or drawn. The fly-wheel may be vaned for the purpose, or even a special fan may be installed.

Another trouble with radial engines is that the lower cylinder may flood with oil, especially when the engine has been stopped for a period. Aeroplane and racing engine practice, however, demonstrated the advantage of the dry sump, which means that unlike the

ordinary car engine, which carries all its oil in the base-chamber, the dry sump engine has a separate oil reservoir, and only sufficient lubricant is supplied to the moving works to keep them well oiled. A further precaution consists in projecting the cylinder partly into the base-chamber, so that a really excessive quantity of oil would have to collect in the base-chamber before it would reach a level high enough to overflow.

An ordinary magneto, working with a separate high-tension distributor, makes it possible to dispense with any specially built and expensive magneto to suit a five- or three-cylinder engine, which seem to be the favourite types for car use. A simple arrangement makes it possible to release the whole engine from its anchorage, or at least to swing the cylinders round; this provision is necessary when some adjustment is needed to the bottom cylinder, which otherwise would be most inaccessible.

There is a good deal to be said in favour of this type of engine. It is extremely powerful in relation to its weight; the length is, of course, very much less than with the ordinary upright unit; it can be cheaply manufactured in big quantities; the valve gear is accessible; the cylinder heads can be made detachable, a feature which allows the carbon to be cleaned out of a fouled engine much more readily, and which also allows the whole interior of the com-



bustion chamber to be machined so that carbon does not collect so readily in any case; also, the engine should be economical in both oil and petrol.

Probably and for a time we shall see them used chiefly on the smaller cars, but there is no apparent reason why they should not be employed on the biggest vehicles. Let just one car prove itself a success with an engine of this type and there will be scores of competitors in a remarkably short time.

For light cars, also, many designers are turning their attention to the horizontally opposed twin engine. This has two cylinders, as the name suggests, and when the design is good remarkable balance and freedom from vibration in running can be secured. The type, at present, is not very well suited to heavier vehicles.

There are to be a number of cars fitted with either one- or two-cylindered engines of the more orthodox type. For low powers there is no serious objection to the use of such units beyond a certain amount of noise and a vibration which, although not really objectionable in itself, seems rather overpowering in comparison with the silence and smooth running of the multi-cylindered units.

CHAPTER XVII

AIR-COOLED CAR ENGINES

THE advantages of the air-cooled engine are admitted, but apart from light cars and cycle-cars there has not yet been any successful application of the principle in this country. Cycle-car builders, faced with the problems of light weight, low cost, and mechanical simplicity, found themselves in the early days with practically no choice but to follow motor-cycle practice and fit air-cooled engines to their machines. As the weight and power of the cars increased, however, water-cooled engines became more popular.

Whether, as is sometimes suggested, buyers dislike air-cooled cars remains to be proved. One has a personal opinion that one really successful air-cooled engine will set the public clamouring for others, but in the beginning it might be advisable to follow at least the general outer lines of more orthodox cars so far as appearance goes. Reliability trials, hill climbs, and bench tests, which are well enough in their way, are not sufficiently convincing, however ;

the cars must be got into the hands of private users, when individual recommendation will do the rest.

Engineers have had unusual opportunities for research and experiment during the last three years, so that it is not without interest now to find that many of them are in favour of air cooling even for the bigger cars. Naturally they must walk before running, for firms of established reputation are not inclined to risk name or income on an entirely novel proposition. The position at present is that air-cooled light cars will be built by one or two of the older makers, who will also continue the construction of the more orthodox units, but newer firms are prepared to stake their whole reputation on air-cooled cars.

The water-cooling system of a car engine is a weighty and complicated affair. The water-jacketed cylinder block itself must of necessity be a heavy casting, while the radiator and its connections, together with the pump and the necessary water for cooling, add considerably to weight. At best the system is in the nature of compromise; although high efficiencies are obtained when the design is good, yet it can be a constant source of trouble and loss. When the system fails overheating follows; when it is too efficient the fuel and oil consumption is extravagant. Connections may leak, water passages choke, and the water freeze, with

disastrous results on pump, radiator, and cylinders. These are some of the disadvantages. A further objection is in the extra manufacturing cost. It must be admitted, however, that the present water-cooling system can be considerably improved by the addition of heat-regulating devices.

The problem now before designers is to provide air-cooled engines that are just as or even more efficient than the other units, in addition to making a saving in weight and simplifying construction. The cooling effect must be equal at all points to prevent distortion, while excessive heat must be dissipated under the most unfavourable running conditions; in fact, overheating must be practically impossible under any working conditions.

Weight can be saved by dispensing with radiator, pump, and water, while the air-cooled cylinder can be machined all over, as in aero-engine practice, though this exactitude should hardly be necessary in the ordinary way; the advantages gained, however, must be considered in relation to the cost involved. The cooling fan must be retained, and air scoops for directing the cool currents fitted. In the final reckoning the weight and cost of these must be set off against the saving made in other directions; on balance the simpler unit should be well on the right side.

If experiments with air-cooled cars now

proceeding prove satisfactory they should be reflected in lower-priced vehicles and reduced upkeep costs, while if coachbuilders take full advantage of the space-saving properties afforded we should be within measurable distance of the light car proper.

CHAPTER XVIII

SPRINGING, STEERING, AND BRAKING SYSTEMS

ALTHOUGH the springing systems in general use are not entirely perfect they can, if the right material is used and the matter be in the hands of a designer who knows what he is aiming for, come very near to giving satisfaction. Along broad lines an agreement has been reached as to what type of springing is best used for different types of vehicle engaged in particular work.

For example, the light car and the cycle-car can have quarter-elliptic springs both front and rear: some chassis have a double quarter suspension at the rear; the touring car may have semi-elliptic springing all round; the heavier car may have semi-elliptic in front and three-quarter elliptic at the back, or semi-elliptic front and back with a supplementary transverse spring at the rear.

There is some difference of opinion as to the respective merits of the standard type of elliptic spring and the cantilever. Some of the best cars have semi-elliptic at the front and cantilever behind, and undoubtedly the latter

can give a very luxurious suspension on heavy cars. Indeed it may be said that on the big cars, apart from racing purposes purely and simply, when the slow periodicity of the cantilever is against it, the cantilever, for the rear springing, has more in its favour than any other type of suspension in general use.

The springing problem, as a matter of fact, is a matter for the designer's own common sense and experience. He has all sorts of details about his particular car to keep in mind when working out the springing and suspension.

Obviously if a car is to be used as a two-seater one type of springing is calculated to give the best results, but if a five-seated body or a big limousine is to be fitted on the same chassis some modification is desirable. The difficulty is that there is no set standard to work to. At twenty miles an hour with three people up and luggage a car may ride as smoothly as a ship in a calm sea. At twice the speed it may be extremely uncomfortable. Half the load and the car also rides well, even at forty miles an hour. In consequence, all the present springing systems in general use are in the nature of compromise. One manufacturer who has specialised for some years in the building of suspension appliances has recently introduced a variable springing system whereby the tension, so to speak, of the springs may be easily

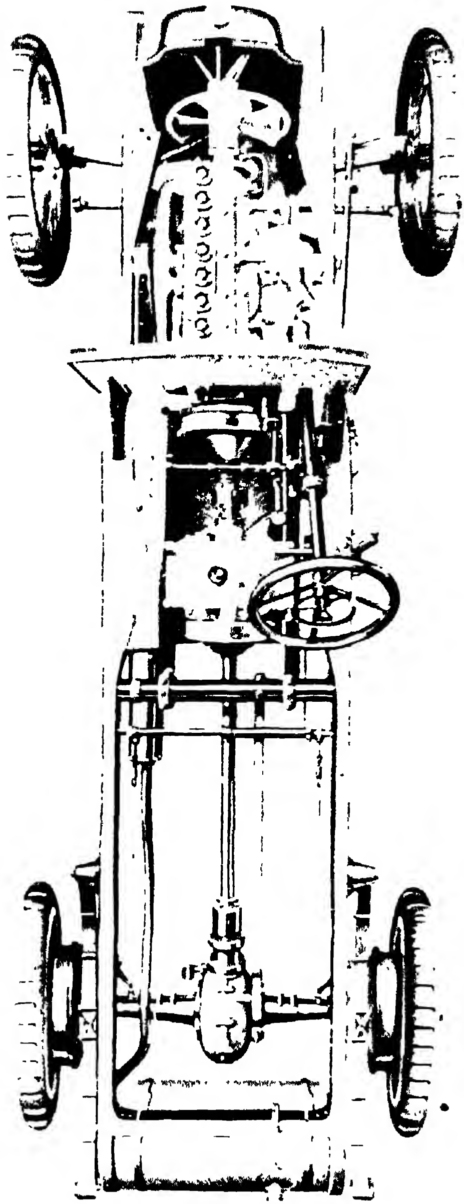
adjusted to suit the load. It is too early to say whether the idea is a practical success or not.

Many designers and engineers are far from satisfied with this state of affairs, and many suggestions have been put forward and experiments made. Before the war an attempt was made to embody a compressed air suspension, and another concern spent a lot of time and money experimenting with a system in which water took the shock.

Actually both these ideas are very promising, but unfortunately the practical application of the theories is a more difficult matter. There is reason to believe, however, that very soon we shall hear more about the progress being made in these directions.

One has the greatest respect for the unorthodox and original designer with the courage to break away from contemporary practice. Of course the rewards are great if the departure proves a success, so long as the public does not take a dislike to the idea regardless of its real merits; on the other hand, especially in the case of a firm with a reputation to maintain, a single failure is apt to react unfavourably for years.

One of the most original springing systems suggested in any of the post-war cars is contained in a car which is, in its way, just as much a departure from standard orthodox



practice as the springing itself. At the time of writing there had been no opportunity of testing the actual car on the road, and therefore it is possible that before it is on sale to the public considerable modifications may have been embodied.

Of course, in order to use an entirely novel springing system, many changes were first of all necessary. The frame demands attention. It is tubular throughout, and consists for the main part of two triangular members placed side by side, with the gear-box suspended from their apexes. The main triangular members are held firmly in position by strong tubular cross members. Practically a continuation of the main members is a tubular extension which carries the engine. The two springs, which take the whole of the suspension, are of the cantilever type, and they are placed parallel to and centrally with the main triangular members. The front end of the forward spring carries the front axle, the rear end being anchored to a short cross-member, and the spring itself being mounted on the main cross-member. The rear spring, which is obviously in line with the front, is also housed on the rear main cross-member, its forward end being anchored to a short cross-member in the same manner as the front spring, while the rear end supports the back axle immediately under the differential casing.

This is merely a rough description of the system, and it must be assumed that proper precautions are taken to maintain the axles in the proper position when the car is in motion, and to dispose of the body and transmission loads. The designer claims that by this system he saves weight without sacrifice of strength, obtains greater simplicity, and, so near as may be, reduces the vertical movement produced by rough roads to something like one half.

Apart from entirely new systems, however, a great many improvements can be made with the standard type of spring. It is the intention of some makers to embody some of these suggested improvements in their post-war cars, but they could be more widely adopted with advantage. First of all, assuming that the springs be accurately designed and built of suitable steels, there is the problem of lubrication. Rust attacks springs very quickly. After a few hundred miles of running the spring leaves on the average car are so rusted together that the part is, to all intents and purposes, a solid block of steel without any particular resilience in it. There are to be had spring insets of a special material in which lubricating graphite is inserted, which are intended for insertion between the leaves of the springs. This is one way of preventing the attacks of rust.

Possibly a better way is for the car maker

to provide adequate oil run-ways between each leaf, so that, after every long run or when the car is washed, the screwing down of a grease-cup cap forces lubricant between each leaf. When this provision is not made the only thing for the careful car owner to do is to force open the leaves in turn and dribble lubricant in with a thin-bladed knife—an unsatisfactory and annoying job at the best of times. Much greater attention than is usually the case can well be paid to the design of the spring shackles.

This is not a blacksmith's job in the modern motor-car; it calls for careful machining and fitting: partly so that the part is amply strong enough, partly that it may wear well, and partly that grit and water may be kept out and lubricant kept in. The grease-cups should be bigger than is usual, and they should be extremely well made, so that the oil or grease may be forced to the parts in contact against pressure.

There is a leather spring gaiter to be had which can be thoroughly recommended. Each gaiter is specially sized to suit any particular spring. It is strapped round at each end, and laced down the middle so that the grease cannot escape when once it is inserted. A small valve is fitted to the upper part of the gaiter for the insertion of grease, and when once the fittings are laced into place and filled with lubricant the spring is safely and adequ-

ately lubricated for six months or more. Until springing systems are greatly improved in many directions it may be said, indeed, that these gaiters are indispensable to any car which is to give easy riding. The maker claims that a well-lubricated spring should, logically, give an economy in both tires and fuel.

Shock absorbers have had a slow and uphill fight for recognition, but they are now finding more general favour. Some makers go so far as to fit some approved type as standard on their cars. The most trustworthy fittings of the sort can be applied to practically all types of springing quite simply, and if the writer were asked to give an opinion as to how best luxurious car riding could be had he would recommend over-size tires inflated to their maker's recommended figure, spring gaiters, and shock absorbers.

As to steering, beyond detail improvements and the use of stronger and lighter materials there is no essential difference between approved practice before the war and now. One should note that there is ample provision for taking up wear, that the steering box and the pillar are securely anchored, and that there is adequate lubrication facility.

This latter precaution means rather more than it sounds, for, in addition to the fitting of grease-cups or spring oilers, the whole of

the steering gear should be designed with a view to protection from grit and water. There is no excuse for making a rough job of a steering knuckle simply because it can be hidden from sight inside a leather cover. It is admittedly difficult to provide adequate lubrication to these parts, partly because there is no pumping action, partly because they are so exposed and the average owner dislikes handling dirty greasy leather, and partly because they, being hard worked, really need more attention and oil than they generally get.

The remedy is to make the parts most carefully, to fit well-made greasers wherever possible, and to make the covers fit really well. The average leather cover may be full of thick grease, and yet the parts in working contact be absolutely free of lubricant. Recently one came across a splendid car wherein thin oil lubricated the whole of the steering-box, an excellent idea, and one that should prove very successful.

Brakes are in much the same category as steering in regard to the improvements made during the last few years. Orthodox practice remains practically unaltered. The majority of cars have a contracting type of band brake immediately behind the gear-box, this being operated by pedal, with the side brake, either of the external contracting or the internal expanding type on the rear

wheels. Some cars have both brakes together on the rear wheel hubs, either internal and external, the one inside the other, or side by side and of the same type. One successful light car has a brake located behind the differential casing—this, by the way, being pre-war practice which the makers have found no cause to abandon. The example has not been widely followed.

The objection to the foot-operated brake somewhere in the transmission is that it makes for backlash and looseness between clutch and road-wheel. On the other hand it is convenient. Both brakes together on the rear hubs are, possibly, all things considered, better engineering practice, but even here there are objections. It is difficult, for example, to provide braking surfaces of adequate size, and if the drums should be too small in diameter or too narrow, overheating in hilly districts is almost unavoidable. Again, an accident to one may conceivably put both out of action, and lead to accident through depriving the car of all braking power.

The foot-brake pedal should be adjustable to suit the reach of different drivers; the connections throughout should be of ample strength; there should be ample room for adjustment on the rods; the various knuckles and joints should, as a general rule, be bushed, so that in case of extreme wear replacement

is a simple matter. Metal to metal brakes, which were extravagant in their use of lubricant, are out of fashion, and most brakes nowadays are lined with a special fabric which has a high friction coefficient and a low rate of deterioration due to heat. One important point to bear in mind is that the brake shoes should be so designed that replacements can readily be made.

There is something to be said about the use of the engine as a brake. There are no really serious objections to the switching off of the ignition when coasting downhill, providing that in doing so the engine is not fouled by the vacuum action of the pistons sucking oil in excess into the combustion chambers; with a closed throttle this does occur. Actually, however, especially because fuels are so uncertain now, the best practice is to fit an extra-air appliance to the engine, and if this be fully opened when the engine is switched off for use as a brake there will be, in addition to a good braking effect, further good done by the scouring, cooling, and cleaning of the cylinders; one could wish, though, that the air used were previously filtered. Of course the vacuum action can be obviated by opening the throttle fully when coasting. This is a costly business which the economical owner can well avoid.

CHAPTER XIX

ABOUT THE AUTOMOBILE ASSOCIATION AND MOTOR UNION

Specially Contributed

THE Automobile Association was created in 1905 by a few motorists who had, during the summer of that year, benefited by an experimental service of cyclist patrols working on the Brighton Road, maintained by one or two prominent motorists, notably Mr. (now Colonel) Charles Jarrott and Mr. W. M. Letts, who were convinced that some protection against police trappists was necessary if the new pastime of motoring was to flourish. In those days every motor-car owner who essayed a journey to the coast was practically foredoomed to police persecution in regard to the twenty-mile speed limit. The police authorities all along the road were concentrating upon the prosecution of motorists, and many thousands of pounds were extracted by way of fines in the local Police Courts, most of which institutions were ruled by motorphobic magistrates.

The Association was born in response to a

widespread demand for protection against malicious anti-motorists. After a start had been made and the Brighton Road taken over, many other much frequented roads were similarly patrolled, and within two years of the date of the first meeting of the small body of founders this new motoring organisation was beginning to count its membership by the thousand.

As fresh members joined, and thereby provided the necessary funds, the A.A. cyclist patrol was seen farther afield—along the Great North Road, in the West of England, and one or two of him were working north of the Tweed. Had the Association never undertaken any other work beyond that of patrolling the roads, it would have justified its existence; but as time went on it became apparent that there were many other services which might be offered to motorists by a live organisation thoroughly *au fait* with motorists' needs.

One of the earliest extensions of A.A. work was in connection with the provision of special facilities for members desirous of taking their cars to the Continent for tours. A start had already been made in regard to the appointment of hotels and motor repairers in Great Britain, and this system was taken to France.

Another landmark in the Association's career was the institution of a scheme for providing Free Legal Defence for every member caught

in the toils of the police in connection with infractions of the Motor Car Act. It may here be put on record that although every motoring organisation has its Free Legal Defence Scheme to-day, it was the Automobile Association which launched the first Free Legal Defence Scheme for motorists. Likewise, the A. A. was the first organisation to erect village signs. Another A.A. innovation was the Roadside Telephone Box.

Additional advantages of membership have followed each other periodically, right through the fourteen years of the Association's history, and have, naturally, further strengthened the hold of the A.A. upon the British motoring fraternity.

When the war was started in July 1914, it found the Association patrolling every main road in the kingdom which mattered to motorists; necessitating the permanent employment of between five and six hundred patrols. Telephones installed along the main roads further assisted the road organisation to serve members' needs; and, above all, an ambitious scheme was about to be launched which was nothing less than an entire reorganisation and overhaul of the British signpost system.

. . . . .

The war is over and the Association is resuming its usual activities in the interests

of members. Moving with the times, it is proposing to undertake other work which has followed the national call for wholesale reconstruction.

One of the most important of all its pre-war tasks is that of ensuring satisfactory and reasonably priced fuel for motor users. If motoring is to expand, fuel at 3*s.* per gallon must make way for something more reasonably priced. To assist toward the much desired drop in petrol prices, the Association has instituted, since the signing of the Armistice, a new Department which does and thinks nothing but motor fuel. Before the war benzol was coming along strongly as a satisfactory alternative to petrol, but the production in this country was small. War demands considerably increased the production of benzol in Great Britain; it is now to be the business of the Association to see that the lessons learnt during the war period are not lost. If this programme is successful, King Petrol will meet a serious competitor, and the future cost of motor fuel to the user will be appreciably reduced. Lively competition by a satisfactory and rival fuel will do more towards bringing down the cost of motoring in regard to fuel than pious hopes and resolutions.

Another task upon which the Association will concentrate its energy is the restoration of the British roads. Five years of war use

has almost ruined some of our principal highways.

Legislation in regard to motoring will need careful watching during the next two or three years. The present Motor Car Act, and practically all the Orders and other regulations controlling the use of motors in the United Kingdom, are out of date and unsuitable for present times. The Association, working in conjunction with the Motor Legislation Committee, which it has recently assisted in creating to deal with these matters, will press for entire revision of the laws now governing motoring, and will see to it that future motor-car laws permit motorists to use their vehicles without the handicap of oppressive and uncalled for distinctions between users of self-propelled and other types of vehicles. Reverting to road matters, the Association has in train developments which will considerably enhance the value of its road patrol system. The A.A. roadside telephone system will be considerably extended, while the risk of breakdown on the road which must be faced by every motorist, no matter how perfect his vehicle may be, is to be further provided against by the system of First Aid motor-cycles fitted with side cars containing a complete outfit of the tools necessary for dealing with minor roadside repairs.

With regard to touring abroad, many motorists who were able to afford this pleasure

in pre-war days would be unable to take their cars across the Channel to-day owing to the considerable increase of taxation on cars entering France—which is now 70 per cent. of the car value. This means that the owner of a moderately powered car, valued at the modest price of £500, would have to find a cash deposit of £350 before it could be shipped to a French port. A.A. members, however, need not be perturbed on this account. The Association has fixed up arrangements whereby the requirements of the French Customs Authorities will be satisfied without calling for deposit of the actual cash. How has it been done? A guarantee by the member's bankers indemnifying the Association in respect of the amount looked for by the French Customs Authorities if the car is not brought back to England.

CHAPTER XX

THE ROYAL AUTOMOBILE CLUB

Specially Contributed by "W. G. P."

THE early history of the Club is the record of a long fight against ignorance and prejudice—ignorance that could not understand how great a field of work lay open to the mechanically propelled vehicle; prejudice against the introduction of anything new. Not until the Locomotives on Highways Act of 1896—the "Emancipation" Act—came into operation was it possible to form the Club. Touring before November 1896 was hopeless, since the law insisted upon an individual walking in front waving a red flag!

The Club was started in December 1897; primarily as a Society of Encouragement for the motor industry, which sadly needed such encouragement; secondly as a social organisation. At the end of that year the membership was 163; at the end of July 1919 it was 15,200, excluding Honorary Members, Overseas and otherwise. The Club's first home was in

Whitehall Court, until 1902, when 119 Piccadilly became the Club House. Then 18 Down Street, part of 16 Down Street and 108 Piccadilly had to be utilised to provide storage room for cars, additional bedrooms, and offices. In 1908 the Club's Scheme of Association, for provincial Motor Clubs and individuals who do not belong to any motor organisation, rendered it necessary to take 112 Piccadilly, which became the Associate-Members' Headquarters. But still the motoring movement grew, with the result that the Club built its present home in Pall Mall, on the site of the old War Office, and opened it in March 1911.

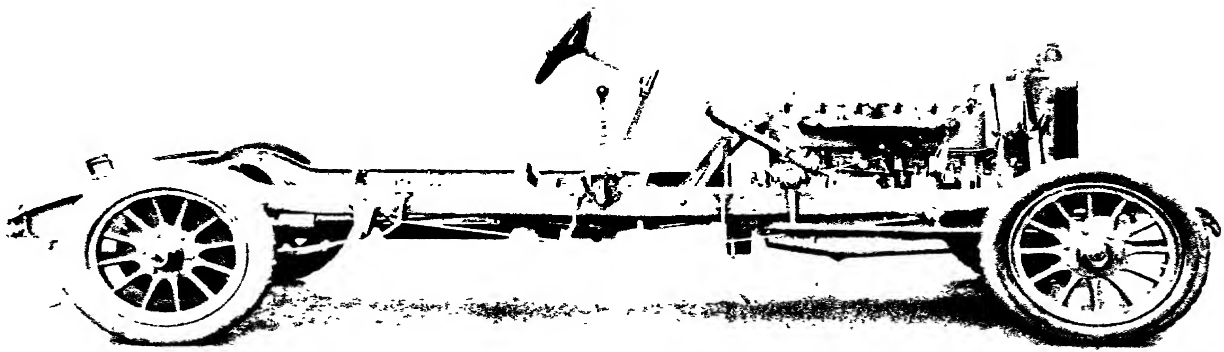
In 1903 the Club was honoured with the patronage of King Edward VII, this patronage being continued in 1910 by King George V. The title "Royal" was bestowed in 1907. King Edward took a personal interest in the design of the handsome car badge, first used in November 1907. H.R.H. the Prince of Wales became Vice-Patron in 1918. The President of the Club is H.R.H. the Duke of Connaught, K.G., and the Chairman is the Hon. Sir Arthur Stanley, G.B.E., C.B.

The Scheme of Association has proved highly popular. Practically all the Motor Clubs and kindred bodies in the United Kingdom are associated with the Club, while other motorists who are not members of any Club can obtain membership of the Association, for the nominal

sum of one guinea, for twelve months from the date of joining. There are many privileges. A fine room on the first floor of the Club House, Pall Mall, is the Associate-Members' Headquarters, and is reached by the western entrance. The National Automobile Clubs of all countries are united in the International Association of Recognised Automobile Clubs, the R.A.C. representing the United Kingdom. The Club has special affiliation agreements with similar organisations all over the world.

The following bodies have been formed by the Club to control various branches of the motoring movement: Motor Vehicle Users' Defence Association; Motor Union (the Users' Defence Association was merged in the Union); Auto-Cycle Club (now the Auto-Cycle Union); Motor Van, Wagon, and Omnibus Users' Association (now the Commercial Motor Users' Association); Motor Yacht Club (now the Royal Motor Yacht Club); and the Ladies' Automobile Club. The Club obtained the control of motor-cycling in 1903, by agreement with the N.C.U. The Self-Propelled Traffic Association was amalgamated with the Club in 1898.

The encouragement of the industry has always remained the primary object of the Club's existence. To this end many Trials and Competitions have been held, each designed to furnish makers with certain information



[illegible] SUNBEAM CHASSIS: THE SIX-CYLINDERED 24 H.P. MODEL.

essential for the development of the motor vehicle on scientific lines. There may be mentioned here the 1,000 Miles Trial and the Trial of Electrical Vehicles of 1900; 500 Miles Trial from Glasgow of 1901; 650 Miles Trial of 1902; 1,000 Miles Trial of 1903; Small Car Trials of 1904; International Tourist Trophy Races in the Isle of Man; Town Motor Carriage Competition of 1906; Dust Trials, Commercial Vehicle Trials, and Side-Slip and Skid Preventing Competition of 1907; International Touring Car Trial and Dust Trials of 1908; Tests of Headlights of 1909--in which year the Club acted as the pioneer of the international adoption of automatic electrical timing; R.A.C Standard Car Race of 1911 and 1912, and Brake Horse-Power Tests in the latter year; R.A.C. Light Car Reliability Trial and Light Car Impromptu Trials of 1914; while mention may also be made of the Club's Show at Richmond in 1899, and the Gordon-Bennett Race and "Irish Fortnight" of 1903.

The R.A.C. Year Book is the Club's annual book of reference. The R.A.C. Rating of Motor Cars is used for taxation purposes. Its "Table of Motor Cars" is used by Government Departments and the principal Insurance Companies. The Club News appears each week in *The Car and Aviation.*

The Club is departmentalised as follows: Legal, Touring, Roads, Road Signs, Press,

Driving and Mechanical Proficiency Certificates, Engineers, Driving Instruction, Technical and Trials, Sports and Recreations, Employment Register, Associate-Members, Touring Guides, House, and General.

The R.A.C. Certified Trial is one of the most useful features of the Club's work. These Trials have the support of both makers of motor-cars and accessories and the general public.

Certain Motor Schools have been officially appointed by the Club, after a thorough examination of the plant and method of instruction, such appointments lasting for one year. To encourage drivers to stay in their situations, the Club issues gold, silver, and bronze medals for continuity of service and good conduct. The "Badge that Will Get You Home" (assistance in case of breakdown on the road) is one of the most popular of the many schemes arranged by the Club.

On the social side Members enjoy privileges at Hurst Park, Goodwood, and other Race Meetings: at Brooklands, Henley Regatta, Richmond Royal Horse Show, Olympia Motor Show, etc. Beyond the usual accommodation of a West End Club there are in the Club a swimming bath, Turkish bath, fencing room, rifle range, squash racquet courts, photographic studio, bowling alley, physical culture room, and other attractions.

The Club's Country House and golf course is at Woodcote Park, near Epsom. The estate has an area of about 338 acres. In addition to the golf course there are lawn tennis courts, both grass and hard, croquet courts, bowling greens, etc. The subscription to the R.A.C. covers the use of both Town and Country Houses.

The story, briefly, of the work done by the Club in the Great War, without any administrative cost to the nation, is full of interest.

Immediately war was declared, it compiled a register of about 13,000 motor-car owners. Then it organised motorists throughout the country, and supplied cars day and night to the authorities for all emergencies; carried officers with despatches to and from the seaboard; conveyed King's Messengers to and from seaports; collected and sent to France at twenty-four hours' notice a detachment of twenty-five owner-drivers with their cars for service at General Headquarters; collected and sent a detachment of forty-six owner-drivers with their cars for service with the Royal Naval Division (Antwerp Expedition); lent its Engineering Staff to the War Office to value impressed lorries, receiving the thanks of the War Office for this service; and provided hundreds of drivers for the R.A.S.C., M.T.

The British Red Cross Society wanted premises, so the Club lent them plenty of

accommodation at 83 Pall Mall, next door. Then—this was soon after war broke out—it was seized with the hospitality idea, and extended Honorary Membership for the war to Overseas officers, convalescent officers, and members of Foreign Commissions; and lent a portion of its property at Woodcote Park for the establishment of a training camp for the University and Public Schools Brigade; the site, after the departure of the Brigade, being used as a convalescent camp.

The leading additional features of the work of 1915 were the organisation of the R.A.C. Owner-Drivers' War Service, under the War Office, to co-operate all over the country; and the raising of a fleet of motor ambulances for Russia, joining, in this matter, with the British Red Cross Society and the Anglo-Russian Hospital at Petrograd. In this year also the Club arranged with the Royal Society of Medicine to supply motor vehicles and drivers during air raids. More drivers were found for the R.A.S.C., M.T. Naval officers on leave were made Honorary Members, for which a letter of thanks came from the Admiralty.

In 1917 the Club became the "Royal Overseas Officers' Club," this name being changed later to the "Royal Club for Officers from Beyond the Seas," because people confused it with the Overseas Club in Aldwych.

Now that the war is over the Club is going

back to its old programme of work as a Society of Encouragement for the motor industry. It has contributed largely to the remarkable development of the industry in this country, and has fulfilled conscientiously all the objects which its founders had in view. Every year the work increases as the movement progresses and new interests arise.

W. G. P.

CHAPTER XXI

POINTS IN REGARD TO INSURANCE THAT THE NEW MOTORIST SHOULD BE FAMILIAR WITH

In connection with motor insurance there is one incident that will long stand out in the writer's memory. It was in the very early days of motoring when touring through the West of England. On Bodmin Moor, in Cornwall, one came across a rather popular French car in difficulties. According to the owner's account the machine had been a constant trouble ever since she had left the workshops, and at that moment the trouble was due to a combination of carburetter and ignition. Time after time both carburetter and engine were primed with petrol until, all of a sudden, a chance spark ignited the fuel and the car was blazing away.

The owner's thoughts turned to the stream that ran along in the valley a hundred yards away, but wiser counsel suggested earth. Everybody worked frantically, but all to no avail. In the end the machine was simply a mass of twisted iron.

Greatly to one's surprise, however, when the job was complete, the owner was jubilant. The writer took on the whole party to the nearest town, where the burned-out owner proved most hospitable. It turned out that his car was well insured, and that he was glad to be rid of her so easily. A day or so later, however, he heard from the insurance company that he had omitted to pay the premium for that year, and joy was quickly merged in sadness.

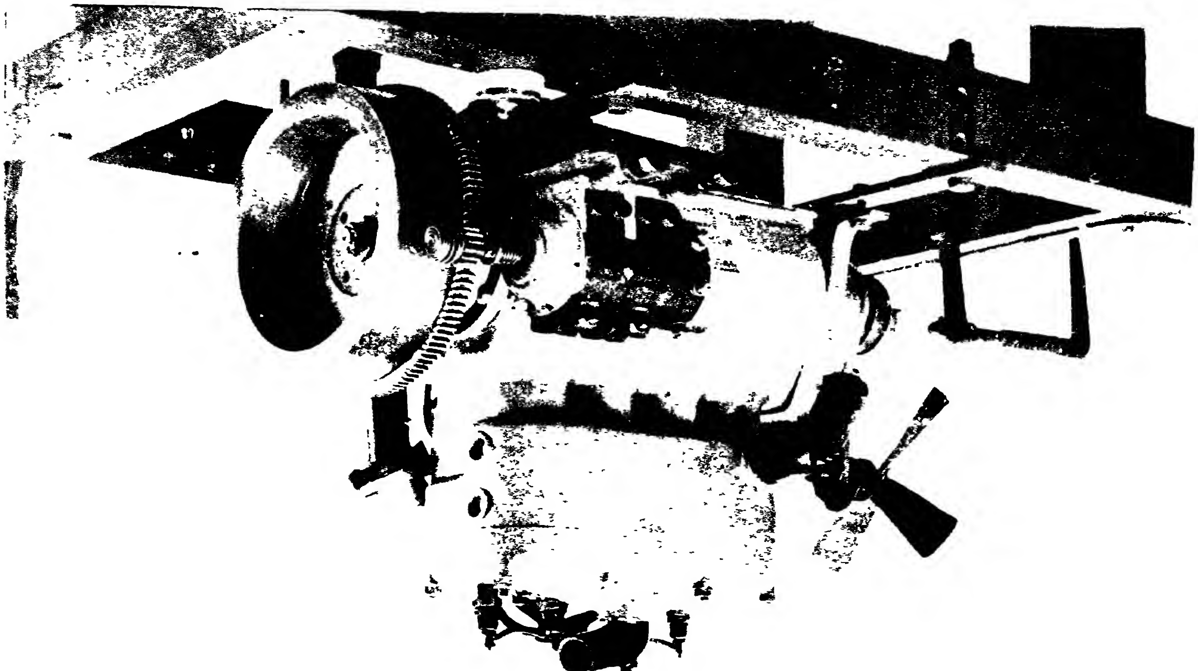
The risks of fire with modern cars are not so great as with the older machines, but they are far from being negligible. Owners must bear in mind that in many cases it is not their own carelessness they must guard against, but that of others. The lighted-match fiend is just as big a danger now as ever he was, and plenty of good cars have been badly damaged through lighted matches being tossed down from passing trams and other vehicles.

Also there are fires in garages to be considered. Some concerns take responsibility in this direction, others do not. Nor can owners pick and choose, especially when touring, in the matter of garages willing to indemnify visitors against loss and damage.

Nobody but a born optimist or a fool cares to drive an uninsured car, whether it belong to himself or not. No matter how skilful a driver a man may be, no matter how carefully

he may proceed when on the road, he can have no guarantee against the foolishness of others. It is no satisfaction to bring an action for damages against the mad-headed butcher's boy who brings about an accident by tearing wildly out from a side-road. Nor can any driver be sure that his car is free from mechanical defect. The brakes may fail either when climbing or descending a hill, and the car itself be damaged or the passengers hurt; or again, the machine, out of control, may injure other road users or private property. All these and hundreds of other events must be guarded against by the owner with any regard for his life or property.

Practically all insurance companies will quote for motor insurance, but the average owner will obtain better treatment by insuring with one of those concerns making a special feature of this class of work. It is not so much that the general company may quibble or refuse to pay, but rather that neither the company nor the car owner understands quite what is required in car insurance. Almost every month that passes sees some new development take place, and obviously it is to the owner's advantage to insure with a concern which has the best knowledge of the conditions governing motoring. The great point for owners to bear in mind is that every possible claim should be covered by the policy. It is almost



impossible to outline the respective points owing to their number, but here are some of the things covered by the one premium in the policy of a leading company.

No countries are excluded from the Continental Cover, nor is any excess required. This means that if the owner should be driving anywhere in the Continent of Europe he is covered for all risks just as he is in England.

Medical expenses up to a fixed sum are paid for personal injuries sustained by the assured or any passenger in the car.

Both owner and his wife are covered in respect of death or loss of limbs.

Fittings, rugs, coats, and general odds and ends in general or particular use about the car are covered against loss by theft, larceny, or fire.

There are substantial reductions in the premium if no claim is lodged within a stated period, or if the owner undertakes responsibility for all costs under a given sum, or if the car is driven by the owner or his paid driver only.

The policy covers the car against accident while it is being driven by any licensed driver, and covers the assured whilst he is being driven in any car other than his own.

This is an important point, for many garages refuse to admit responsibilty for accident to customer's cars whilst they are being delivered or tested.

Repairs up to any amount can be carried out by any responsible repairer, and, in the later policies, it is not necessary for the permission of the insurance company to be obtained before the repairs are put in hand.

Third party claims are fully covered, and, in addition to all these things, the insurance company is prepared to supply technical advice free of cost and, in certain instances, to undertake the legal defence in case of proceedings arising out of some act by the car owner.

There are, however, some ways in which even the best of the insurance policies can be amended. For example, there seems to be an idea in the minds of some companies that cheap cars are more liable to damage by fire than the more costly vehicles. Why this should be so it is hard to say. Probably the idea is that owners are likely to be more careless and inexperienced. It is doubtful whether the actual statistics bear out the companies' contention.

Why a more powerful car should be charged extra in its premiums for damage done by it is hard to say. The average insurance company, however, has an idea that a 60 h.p. car does more damage, especially to a third party, than a 20 h.p. Ford, for example. The reasoning is not very clear, particularly as it rather reverses other rulings ; one would imagine, for instance, that the bigger car would have a more experienced and careful driver in the

general order of things, and therefore would be less likely either to meet with accident itself or to damage other people. Nor is it quite clear why there should be an idea that only cheap and common cars are subject to the attentions of the motor thief. As a matter of fact, although the conditions in 1919 were rather unusual, there were more expensive cars stolen than cheap ones. Probably the companies think that the standardised and cheaper cars are easier for strange drivers to handle, while there is less chance of their being identified after they are stolen.

The price of the car itself cannot altogether be used as a basis on which to base premiums, for some very costly cars are of comparatively small rated power, while a great many cheaper cars rank as being quite powerful. For the same reason the power of the machine itself cannot be used as a basis.

The companies should, as a matter of fact, carry the individual circumstances of each car's use further than they do. Some attention ought to be given to the kind of country over which the machine is to operate ; whether it is a suitable vehicle for the country itself ; the previous record of the driver. In other words, the personal element should be more carefully considered than it is in the general run of things. All the companies of any standing already maintain a big inspection staff, and it

would not be difficult, although naturally there is keen competition for business, for a personal inspection to be made by some representative of the company before the policy is issued. As matters now stand any owner can apply for a policy for any reasonable amount, and have his application accepted without further investigation. For example, a really good car whose brakes, however, are out of order, would be accepted, and if an accident occurred the company would be called upon to pay. If suspicious circumstances arose in connection with the matter there may be investigation or even refusal to pay; but no concern cares to have trouble of this kind, and in many cases the claim is met even though it be dubious in the extreme. Because of this fact the careful owner must pay more for his insurance simply to meet the losses incurred by the careless or unscrupulous driver.

Of course the best safeguard from the companies' point of view is when the owner undertakes to bear the first 10 or 20 per cent. of all damage sustained by fire, theft, or other troubles. The new owner, who is not at all sure about this matter of insurance, would be well advised to get into touch with either the Royal Automobile Club or the Automobile Association and Motor Union. It is, of course, a pity that all the motoring organisations cannot get together, and pool their efforts in the cause of

motorists. As it is both give excellent service for a very small fee, and although both have been severely criticised there is no doubt that if motorists care to make use of the facilities available they will receive ample value for their money.

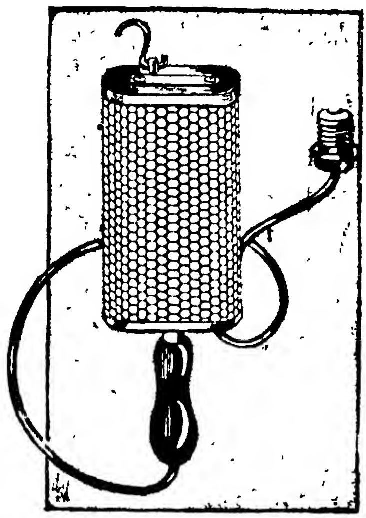
CHAPTER XXII

WARMTH IN MOTORING

In cold weather the need of some convenient means of heating the car is very evident. We have not yet reached the scientific exactitude of the Chicago hog-packer, and, unfortunately, a great many things besides squeaks are wasted even in the best of cars. Every engineer regrets the wasted heat—which is in effect wasted power—of radiators and exhausts, and has so far sought in vain for a remedy. As often happens, those with least real knowledge of a problem sometimes take a more practical view, and see further than others who have made a special study of it. The motorist is not particularly concerned with involved calculations. With a child's clear insight into the heart of things, he knows that he is cold when driving, and that there is much wasted heat in the exhaust. Why, then, he wonders, cannot the heat be taken from where it does no good to where it would be very much appreciated?

In the first place, body design is at fault in cars that are particularly draughty. Some

are colder than others, but the old-fashioned tonneau, with its high sides and door at the back, was warmer altogether, even allowing for the difference in speed, than the low-built cars of to-day. Back draughts seem inseparable from modern cars, but even if every pos-

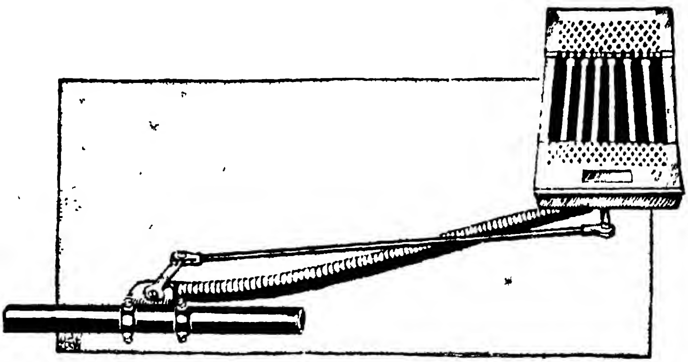


A HEATER TO HANG INSIDE THE ENGINE BONNET DURING FROST

sible improvement were made, artificial heating would still be necessary to comfort on cold days. The American accessory makers have given this matter more attention than we have, probably because of their longer and colder winters, which, in some parts of the United States, make motoring practically impossible unless cars are artificially heated. There are

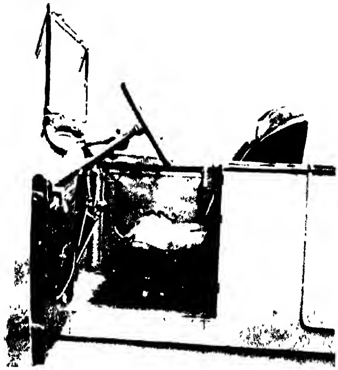
not many days in this country when the conditions are so bad as this, but there are certainly a great many when motoring in unheated cars is distinctly uncomfortable, if not exactly impossible.

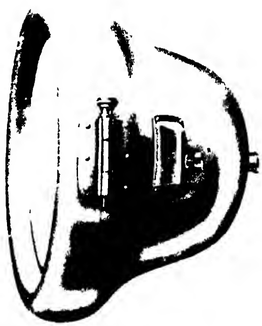
Electric heaters, excellent in many ways, are hardly practicable owing chiefly to heavy first cost and upkeep. A hot-water system



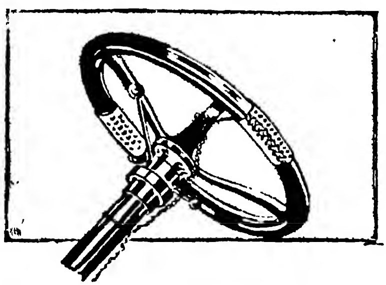
A FOOT-WARMER HEATED FROM THE EXHAUST PIPE THROUGH AN ARMOURED HOSE.

sounds very promising, but a simple and efficient lay-out is hard to come by; and although a designer began with the best intentions, a very complicated apparatus would ensue before he had finished. If the supply for such a system were taken from the radiator, the engine cooling could easily be upset, with direct and unfavourable results on power and economy; if a separate water system were fitted, taking heat from exhaust, the





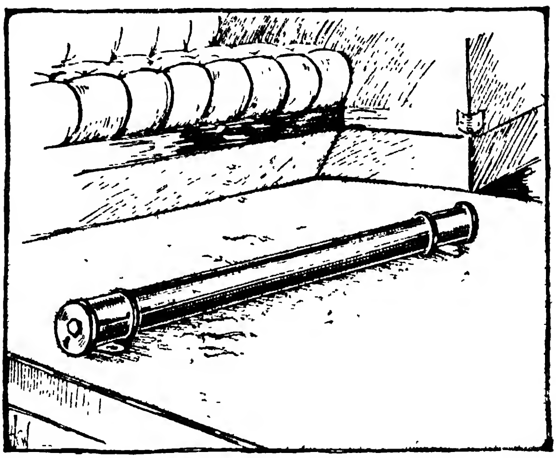
additional weight would be considerable; and no benefit would be had until the engine had been running for some time. Incidentally hot-water heating is open to the same charge of undue cost. For all practical purposes the simplest type of heater, which consists of tubes heated directly from the exhaust pipe, is the best. Its greatest disadvantage is that no efficient form of regulator has yet been devised,



ELECTRICALLY HEATED GRIPS FOR THE STEERING WHEEL.

and excessive heat can be just as uncomfortable as extreme cold, apart from the danger of setting the car itself on fire. In one such appliance the heating units are enclosed in a perforated grating set flush with the floor-boards, the heat being taken from the exhaust pipe through a muff and an armoured flexible tube. A valve is placed close to the grating, to regulate the amount of heated air passing through. This idea is capable of considerable extension.

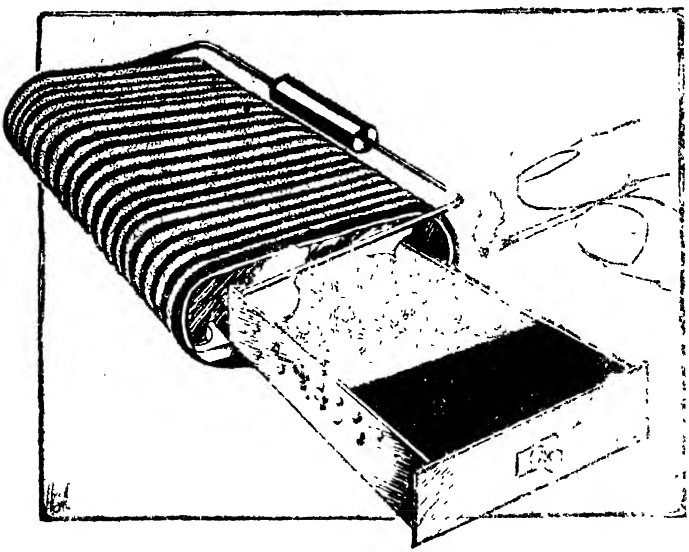
Cold hands when driving are a nuisance and a source of potential danger, yet no glove made seems able to keep the hands warm during a long winter drive. One recalls that before the war an ingenious person had devised flexible grips, which were to be laced in position on the rim of the steering wheel. Incorporated



A HEATED FOOT RAIL.

in the fabric of the grips was an electric resistance taking its current from a small battery, and controlled by a switch, so that in action the device was maintained at a pleasing temperature. This appliance seemed simple and practical. Now that the war is over it might be worth the while of some enterprising manufacturer to market the grips on a suitable scale, especially if the selling cost could be

made reasonably low. Portable foot-warmers have never been favoured by motorists for their passengers, although in the old carriage days everybody used them. Modified types of portable heaters can now be had, and because of their lightness and convenience have a chance



A DEVICE WHICH USES SOLIDIFIED SPIRIT.

of attaining some degree of favour. The majority use solidified fuel in the form of small briquettes, which are lighted with a match, one supply lasting for some hours. It is claimed that there is not the slightest danger of fire, but as to this one has only the assurance of the makers.

CHAPTER XXIII

THE LUBRICATION OF MOTOR-CARS

So far there is no car with a perfect lubrication system throughout—as the specialist understands perfection—but just before the war there were one or two projected chassis which gave evidence of careful and intelligent study in this respect; possibly we shall hear more of these machines now that experimental research is again possible.

Insufficient attention is given to those small fittings, such as grease-cups, ball-spring oilers, and so forth, on the proper working of which so much depends. Obviously, the screw-down grease-cup is of little value if the lubricant cannot be forced to the bearing, while the ball-spring oiler is of small worth if the oil channel itself be blocked. These are trivial matters, for the neglect of which makers cannot be excused. Other problems, however, are not nearly so simple, for lubrication has come to be something of a science, so that now it is not sufficient merely to keep out grit and water while supplying lubricant of a sort to the

working parts, but rather it is necessary to supply specialised lubricant with mechanical exactitude and in calculated quantity. From the owner's point of view the ideal lubrication system would comprise an accessible oil tank, to be replenished when the supply ran low, whence every moving part on engine and transmission would be automatically supplied. Perhaps this is too much to ask at present, but there is no reason at all why the 1919–20 cars should not embody considerable lubrication improvements, possibly along the following lines.

Aero engine work has proved valuable to car designers in general, and especially to those without racing-car experience, for the engine lubrication systems used on racing cars and water-cooled aero engines have much in common. In the high-speed, high-efficiency engines, towards which British car design tends, it is necessary automatically to supply oil at a suitable temperature and in nicely calculated quantity—a variable factor dependent on engine speed—to all reciprocating parts in contact. Mechanically the problem is comparatively simple, for there are engines now being built which are a marked improvement on even the best practice of 1914; but further attention could profitably be directed towards improvement of the oil-filtration system.

The clutch spigot is subject to exceptionally

hard usage, but the lubricating facilities given it are often inadequate. One has heard, indeed, of clutch spigot lubricating facilities that actually were not facilities at all! An oil-cup or greaser which can only be reached by removing the footboards is apt to be neglected by the average owner, and there is much in favour of the suggestion, which has already been given practical application, that the clutch spigot should be automatically lubricated from the engine reservoir when the clutch pedal is operated. One has to remember that owners dislike anything in the way of drudgery, and rather than foul hands and clothes with oil will neglect the lubrication of some important but inaccessible part even to the verge of disaster.

The universal joints in common use are not designed or lubricated to comply with scientific standards. When carrying a load of up to 3,000lb. per sq. inch something better is needed than a rough-and-ready outer casing with a semi-solid grease for lubricant. A flexible leak-proof case, with the joint oil-lubricated from the inside, leaving centrifugal action to carry the oil to all parts in contact, would be a decided improvement. It is a difficult job at best, however, and one that the average designer may well shirk, yet it is one that can and should be tackled.

Not so very long ago there were few gear-boxes wherein, when oil was used, leakage did not

occur. The obvious remedy was to use thick lubricant, but this practice is attended, unfortunately, with a serious falling-off in transmission efficiency. Nowadays a compromise has been reached; the gear-boxes are better made, and if semi-solid lubricant be used leakage is avoided, while the gears are fairly silent in operation, particularly on direct drive. Efficiency is low, however, owing partly to the dragging action of the grease and partly to the fact that sometimes the gears, when running at high speeds, throw the grease by centrifugal action to the sides of the box and consequently work unlubricated. In a way the objection could be overcome by stuffing the box full of grease, but even this practice is attended by complication, for if the grease be too solid the gears cut channels in it, while if the lubricant be too thin the old weakness of leakage again manifests itself. Improved gear-box construction would use thin oil only; some development of the individual trough system, wherein the teeth of each wheel dip, and possibly in combination with a spray of oil directed against each pair of wheels in mesh, is indicated. The National Physical Laboratory in a test with a gear-box from a 32 h.p. Leyland chassis found the efficiency of the direct drive was only 74 per cent. with the box full of oil, while an efficiency of 97·5 per cent. was had with the box only a quarter full.

So far as the back-axle is concerned, the same objections that are urged against conventional gear-box lubrication practice apply. Some system of supplying thin oil to the gears at the point of meshing is needed, and it is desirable that the whole of the back-axle components, differential gearing, and wheel bearings should be automatically fed from the same oiling system.

The primitive method of filling the wheel hub-caps with grease certainly supplies the bearing with lubricant for some period of running, but the method is extravagant, and as soon as the pressure exerted on the grease by the hub-cap is removed the bearing runs dry. A common complaint in these days particularly with the older cars, is that the front wheels come adrift almost without warning. Periodical examination, obviously, would disclose the wear, which is directly due to poor lubrication. This, however, is just the point and the strongest argument in favour of better oiling systems: that the average owner neglects his car even to the danger point. It is the maker's business to provide adequate and long-lived oil-retaining devices for all parts from which water and grit must be excluded, without, however, undue friction on any moving part.

CHAPTER XXIV

BETTER SERVICE FOR MOTORISTS

THE need of a better service system for motorists has often been emphasised. Motorists, naturally, welcome the idea, for they stand to gain in every way if the various schemes put forward since the war are successful, and they have nothing to lose in the other case. Road troubles will lose much of their terror when well-equipped, standardised garages are operating in all the big towns, and, logically, the cost of motoring should be reduced. The average English garage—indeed, the average garage in any country—cannot truthfully be called a satisfactory establishment from the car-owner's point of view. There are some outstanding exceptions whose success justifies the belief that there is ample room for a big development of a scheme for rendering practical car service.

The garages are not always to blame for their inability to meet all the demands made on them. Small agents in country towns cannot afford to lock up a big capital sum in

spare parts for numbers of different makes of cars, and unfortunately the car makers are not strong enough to back all garages, for obviously they cannot afford to supply stock promiscuously on the sale or return system. The best they can do, in the interests of their own customers, is to make it a condition of agency agreements that local depots must carry a certain quantity of spares. If the local agent is an enterprising man who is handling a popular car he can afford to carry more than the agreed amount, and his customers benefit accordingly; but most depots are not well supplied, and therefore the ordinary car owner is handicapped.

At present there is no standard in car service, and motorists are at the entire mercy of circumstance. By good fortune they may, when trouble arises, select a well-equipped garage and receive prompt and competent service at a reasonable cost: on the other hand, they have a good chance of receiving only disservice at an exorbitant cost. Garage-owning does not rank as a profession, so it is impossible to prevent any person, whatever his qualifications or lack of them, from setting up in business as a repairer. It should not be difficult, however, to set a standard of service which would inform the motorist as to what could be reasonably expected, and which by the operation of the competitive law would improve the general

standard and, in the course of time, eliminate the unsatisfactory establishments.

The scheme now in mind involves standardised depots in the big centres throughout the country, supplemented by smaller establishments in convenient locations. It calls for adequate capital, for even one well-equipped service station could very well represent an investment of £10,000 to £50,000. In any scheme aiming at a general service to motorists, however, it is essential that the management be independent, for the essence of the idea lies in broadness of scope; the restricted view would kill it. So far as the depots go it should make no difference in the value given to the customer whether repairs be made to a cheap light-weight motor-cycle or a costly limousine. It is beyond the individual maker's province to institute service of this nature, for even if he had sufficient capital to equip a chain of depots throughout the country they would, naturally, exist chiefly in sectional interests.

So far as possible the big central service establishments, which would need to be very completely equipped, would work in close touch with the smaller depots; the whole would be controlled from a central headquarters. The smaller places, confronted with a task beyond their power, would get into touch with the nearest pivotal depot, and this in turn, if some special facility not carried in the ordinary

establishment equipment were required, would indent on headquarters.

Buying would be done from the main establishment and would be based, naturally, on demands from the branches. In this way distinct economies would result, for manufacturers would be able to supply spares at a lower cost when big orders were given for them, while customers would be assured of getting guaranteed parts at a standard price. The general economy effected by such a comprehensive working scheme is unquestionable, though much depends, of course, on the efficiency of the administration. Many manufacturers do not wish to continue making spare parts for their old machines. In such cases, when the demand justifies it, a service company could arrange with some other factory for supply. Through the chain of stations it would be possible to gain a better general idea of current needs, while sudden demands could be met by concentrating from the various depots, and surplus stock in one could be satisfactorily disposed of at another.

A general complaint is that there is no set charge for car repairs. Every garage fixes its own prices, which are often based on what the customer can pay, while in many instances the worse the service the higher the prices. Owners are justly irritated when there are no standard charges for garaging a car over-night, or for

every-day work, such as washing and cleaning. Such complaints, however, are not always justified, for it is difficult to set a standard price owing to widely differing circumstances. The garages of Central London cannot compete in the matter of price with an obscure establishment in a small country town; further, some regard must be paid to the vehicle itself, for where every inch of space is valuable, the cost of housing a big limousine must be higher than for a small two-seater. Many of the troubles could be overcome by every garage having a fixed scale of charges prominently displayed in such a position that there could be no reason for owners to dispute the bill.

Because there is no technical standard of efficiency for garage mechanics the motorist, possibly held up by some trivial mechanical failure, is at the mercy of an untrained man, whose knowledge of the machine he is called on to adjust is less than that of the troubled owner himself; the most annoying circumstance in such a case is that, although the unskilled man is paid at the lowest labour rate, the customer is charged for at the highest. Standardised service could make this difficult by guaranteeing all work done. Motor-cars occasionally develop the most elusive troubles, and on a wrong diagnosis the customer may be charged for totally unnecessary work and find himself no better off in the end. No repairs should be

put in hand except on express instructions, or on the owner's acceptance of a written estimate stating just what work and renewals are necessary, together with the approximate prices. On the car being taken over after repair, there should be some indication that the work charged for has actually been carried out to the satisfaction of some responsible person. In this way both sides are protected.

In many small matters there is ample room for a general improvement. What motorist has not been exasperated almost beyond endurance by the ineffective struggles of garage men to inflate tires to the advised pressure by means of an inadequate pump, undersized for its work, and in a bad state of repair? A man may struggle for half an hour under such a handicap and, although little improvement is made, he naturally expects to be paid for his exertions. The well-equipped garage should contain an air compressor capable of rapidly and with the minimum of trouble inflating even the biggest tires to full pressure; at least for regular customers small services of this nature could well be given without charge.

CHAPTER XXV

THE ARGUMENTS FOR AND AGAINST AMERICAN CARS

AMERICAN cars in this country have been responsible for a good deal of alleged humour. On the whole, however, one would imagine that the owners of the machines have had that last laugh which is supposed to outweigh all the others. Before condemning the machines or their makers we must make an attempt to understand the different point of view which led to their appearance in the first place.

It should be remembered that the average American is not nearly so conservative as the average European, especially where machinery is concerned. Conservatism is, indeed, in many ways, simply a term for dislike of progress. The more conservative a country is, the more it dislikes changes and innovations. Countries such as China and Spain spring readily to the mind in this connection.

The American has no sentiment where machinery is in question. It exists for him merely as a convenience or a profit maker,

and when it falls short in either of these capacities it is ruthlessly scrapped. We are beginning to take this view in England, but it is not so very long ago that we took the direct opposite.

The writer remembers that in the engineering shops, of a famous engineer and shipbuilder, where he served his apprenticeship, there was one old machine that was the general pride. It was a great vertical shaping machine, its year of origin being 1839, if memory serves correctly. We used to be quite proud that the old friend was still in service, but very few of us realised that every piece of work done on the machine cost about ten times as much as it would have done on modern plant; it was as though a railway company kept the Rocket in commission simply because of sentiment.

Not so very long ago we regarded cars in the same light. Makers liked to believe that the machines would go on running for twenty years. But who wants a car to run for this period? If there were no progress in design being made, well and good. But there is, and when a car is a few years old it is obviously old-fashioned. It is not altogether a matter of appearance. but more one of running cost. If the 20 h.p. car of to-day is 5 cwts. lighter than the car of 1912, and is also quicker, it must, logically, be considerably cheaper to run, apart altogether from repair costs.

The American engineer does not want cars that will last for years and years. Maybe they will run for twenty years if put to it, but the argument is that within a year or two progress in design and construction makes the old cars uneconomical, and therefore they should be displaced. Three years, for example, may be taken as a fair life.

In the first place the machine costs, say, approximately £300. At the end of three years it is sold for whatever it will bring to some person just making a start in motoring, or to somebody to whom first cost is more serious than maintenance. Assume the vehicle brings £100. An improved car of the same type can probably be bought for about £275, so the motorist must provide £175 in fresh capital. Three years later he sells again for about £100. A simple calculation shows that the capital cost of his motoring comes to £375—at least one hopes it does! Figures, however, were never one's strong point—for six years, and this, as things go, compares very favourably.

A car of much the same construction, but better finished, especially to suit individual taste, would have cost in England before the war, about £500–£600. At the end of six years the vehicle would be worth somewhere between £200–£300, according to the way it had been looked after. For the last three years, at least, it would have been noticeably

out of date, the percentage of repair costs would have shown a progressive increase, the running costs would have compared unfavourably with those of later cars, and the inconvenience would have been considerable. For example, no engine starter would have been fitted.

Another simple calculation will show that the buyer must make a greater initial outlay in the case of the English car, while the depreciation would be, very roughly, about the same, or there would be a slight balance in favour of the American. A great deal, of course, always depends on the owner and the methods he adopts with his car; as a general rule the year of manufacture has as much to do with the selling price of a second-hand machine as its mechanical condition. This, at least, was the case in normal times.

The argument thus put forth is perfectly reasonable, and is strongly supported by facts. But whether it is that the average Britisher has not yet got rid of his innate conservatism, or whether he is merely wooden-headed or not, is hard to say, but the truth is that he prefers his more expensive British car. He would like many improvements to be made. Engine-starters as standard—of course they are in the new cars—a very complete equipment, coupled with a big reduction in price.

Some day a genius will arise who will com-

bine the best points of the American cars with the distinctive character of the British product. When this genius does come his rivals will either have to follow in his footsteps as best they can, or go out of business. The latest American cars to come over are much better finished than the 1914 models, but they still fall short of our best standards.

As a matter of fact we do, as a nation, carry our love of finish and a "good job" a little too far. During the war, when millions of shells were being fired away, our men in the field used to wonder why our shells should be so carefully painted and finished. Actually much of the work was unnecessary, but it was instinctive.

Like most other things, the cost of American cars is rising. It will be a long time before we shall have the completely equipped machine at £250 as we used to in 1914. Some of the big six-cylindered machines, in fact, that came over in the summer of 1919, and were subject to a $33\frac{1}{3}$ tax, were priced in England at nearly £1,000.

The following extract from an article by the writer, which appeared in *The Times* of September 8th, explains some of the difficulties that British makers were faced with, and why they were not very anxious that the U.S.A. products should be imported without restriction.

"The makers of the more expensive British cars are not particularly perturbed by the lifting of the embargo on the import of motors and accessories. Where price ranks second to quality the British maker has long been supreme in the world's markets, nor is there any reason to suppose that a change is likely to take place. One or two of our factories, in fact, would have no difficulty in selling the whole of their outputs for years to come, at more than list prices, in the French, Italian, U.S., and South American markets solely.

"These costly cars, however, represent only a section of the British motor industry, and most manufacturers are gravely concerned about the immediate future, now that unrestricted import is to be allowed. Our factories have not changed over from war to peace work so swiftly as was hoped would be the case. There are a score of reasons for the delay, but the chief is that the whole nation is afflicted with a 'slow strike.' One of the biggest motor manufacturing concerns estimates that its present output per man is less than half that of 1914, and less than one third that of the war period. This, of course, is felt in many ways. It affects raw material supplies and prices, transport, the delivery of component parts and accessories, castings, stampings, forgings, and so forth.

"The war has demonstrated to Europe that

motors are a necessity in civilised countries, and more than ever a necessity in industrial communities. Just as this fact is being appreciated, the whole of the Western Continent has realised that there is a world-wide lack of motors. The Allied countries have not produced, other than for war purposes, any motors for nearly five years. The United States of America will be almost 2,500,000 vehicles short on normal requirements by the beginning of next year, although the bulk of the American factories never reached a 100 per cent. war basis. In Great Britain a large percentage of the motors built for war purposes were used up in the war itself, others are unsuited for commercial employment; there is no legitimate labour or material to repair the bulk of those remaining, while the fractional percentage left can have little immediate effect in meeting the need.

"The leading authorities in the United States of America estimate that even if the American motor production is doubled next year it will take three years for supply to equal demand. What this means can be grasped by considering that at the present time thirty-three representative U.S.A. factories are producing a daily total of 6,646 vehicles, and this in the face of strikes and disputes. Before the war the normal annual increase in American motor production was 40 per cent. Excluding Fords, the total

1916 output was 1,493,617 motors, while in the following year the total was 1,737,151.

"Prices are rising, but not on the European scale. From January 1 of this year to July 24 the average price increase of forty-nine representative cars was 7·6 per cent. A leading American motor journal comments on this fact in the following words: 'These are the days when the superior manufacturing methods of the industry demonstrate their intrinsic value. This is probably the real explanation of the ability of motor-car manufacturers to meet the present situation without creating exorbitant prices for their vehicles. Truly it is a real credit to American automotive manufacturing and assembly methods.'

"Whatever the causes, the hard fact is that the United States of America are in motor production on a big scale, while the British factories are not, through no fault of the latter.

"The American manufacturer is a business man. His huge home market is safely secured to him, for no country can produce on the scale necessary to supply itself and also to invade the U.S.A. market, other than in very specialised classes of vehicle. There can be no other conclusion, therefore, but that the American manufacturer will strain every nerve to develop the foreign even at the temporary expense of the home market. Indeed, he has

no need to seek these foreign markets, for they are being forced on him. The armistice was barely signed before Detroit, the citadel of the American motor manufacturer, was besieged by European buyers clamouring for vehicles at a time when no European country had lifted its embargo on motor import. It is largely due to the pressure then brought to bear that there are so many American motors ready to be brought into this country so soon as freight can be found for their transportation.

"Before the war we received mostly cheap cars from the U.S.A., but there is evidence to-day that our medium-priced, and even our hitherto exclusive markets, are to be invaded. Cars like the 'Big Six' Studebaker, the King 'Eight,' the Cadillac, the Roamer, and the Hudson will compete with our own cars selling at between £650 and £1,200. Possibly these prices, in case of need, carry a sufficient margin to allow for reduction; at present they are readily obtained because very few British-built cars are to be had at any price.

"In commercial motors, a field exclusively developed by the British manufacturer before the war, in which we had established our biggest lead, there will be most strenuous competition. America will send over every class of machine, from the light-pneumatic-tyred van to the heavy three-ton vehicle. Once in the country the machines will be in service for

years, because, for economic reasons, traders cannot change without incurring extra costs. Standardisation in transport is important, and the Americans are now in a position to consolidate any market they can secure an entry into by following up with a good service system.

"Harley-Davidson, Indian, Henderson, Excelsior, and other motor-cycles, both light and heavy, will cut into markets that took us years to develop. As for the money spent in developing the farm tractor, it can be reckoned as lost for good if unrestricted imports are to be allowed. Only in steam tractors, in fact, would we be without competition in the British market.

"Serious as all this is, there is no need for panic legislation. Eventually the motor industry must fight its own battles, and if it cannot compete in a fair field it must go under. The industry of the whole Empire (we must look farther than Great Britain) cannot be allowed to suffer by a lack of motor transport. In full realisation of this fact, all that responsible members of the motor trade now ask is that they shall be adequately protected during the transitionary period, a period made doubly difficult owing to the big factory extensions made at the request of the Government during the war."

CHAPTER XXVI

THE PLEASURES OF CAMPING WITH A CAR

In the old days the camper was regarded either as something of a harum-scarum person, or the taste was regarded as one peculiar to extreme youth, and one's friends hoped it would be grown out of—like measles. A great many people have, however, during the war, acquired the outdoor and camping habit, so that what was once the pleasure of a few has become a regular habit of the many.

The accommodation afforded by the hotels, and the great difficulty in obtaining casual accommodation of any sort while touring, especially during the summer of 1919, has also had a lot to do with the fixation of the habit, if the word be permissible. One remembers the very fascinating old charges of pre-war days, when a whole party could sometimes stay for days in some out-of-the-way place, be fed on the best food, be treated as honoured guests, and have a bill in the end that amounted to a matter of shillings merely.

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time. Everywhere one now hears expressions of disgust at the profiteering habit, which seems to have penetrated into the remotest parts of the country. The writer spent a good part of the summer of 1919 on the road; his party consisted of three grown-ups and two small children, and averaging the charges for a night's accommodation, which meant three dinners and two suppers (for the children), two large bedrooms, and five breakfasts, the sum came to just under £5.

One realises, naturally, that the cost of all commodities has increased, but at the same time a charge of nearly a pound a head, including the nurse and two young children, is exorbitant, especially in view of the fact that the accommodation was often only third-rate. What the first-rate rooms cost in order to bring up the average, may best be left to the reader's imagination.

All this sort of thing, however, is simply increasing the determination of many people to become independent of the exploiters. The writer is an enthusiastic camper, but he is not going to be so stupid as to say that if camping is once tried no other holiday will appeal in the future. There is a time for camping as for all other things. Various conditions are needed to make the holiday a success. If all things fit in, the camping holiday with a car will be found both enter-

taining, healthy, and very cheap in comparison.

Weather is the most uncertain factor. Personally one has been unlucky in July, and has come to the conclusion that June, especially in the north, is more likely to provide good weather, while in the south either August or September makes a good gamble. With a car there is always an opportunity, of course, of making a move either to a town or to a different part of the country in case of bad weather. Indeed cases have been known where lazy, bored campers have sneaked away the car and spent the day—four in all—in Paignton, until the weather improved, leaving an unfortunate individual, whose name shall be unknown, responsible for the camp.

Fortunately, and as showing how a kindly Fate balances out things, that deserted person came across a local estate owner possessed of many sporting facilities, together with an excellent cook and cellar, so that, recounting experiences afterwards, he was, in golfing language, "Nine up at the turn!"

Select one's party carefully. This is the golden rule for camping. Everybody must be of an equable temperament, be ready to turn his or her hand to any job that turns up, not too ready to grouse, have a sense of humour for the "off" days, and be ready either to entertain himself or others of the party.

Incidentally a sense of discipline is the finest thing the writer has come across in making for a happy camping party. One always, after a long experience, appoints some member of the party to be camp captain for the day, and it is this honorary officer that arranges amusements, food, camp cleaning, and so forth. His instructions, however, must be implicitly obeyed.

Personally I am a lazy person. All my camping gear can be got into a rucksac and a bag of golf clubs. A bell-tent, pitched within a mile of both beach and a reasonably good links supplies everything to make me perfectly happy for a month. If Sunday play is not allowed, so much the better, for then one can write all the week's articles without, so to speak, wasting good time!

Seriously, however, a little forethought is really needed. One must have, for example, a suitable kit—a kit containing everything likely to be needed, but nothing that is simply an encumbrance. A little tact is needed in this respect, especially if ladies go to the making of the party. It should not be a difficult matter to convince the best wife and the finest sportsman (a dual personality) in the world, that a black hat stuck all over with those attenuated ostrich feathers that the ladies wore in 1919, is an unnecessary camping adjunct—but it is!

"The more the clobber the harder the work" is a fairly sound rule to work to, and "The harder the work the less time for fun" may be added. Cut the personal luggage down to a minimum. Starched things are obviously out of place either when touring or camping, while generally speaking the older the things are the better for the purpose. Flannel and khaki may sound a bit crude, but if one should go to an hotel for an occasional meal they are infinitely better than travel-stained white clothes. One needs comfortable boots, good woollens, and a complete spare change in case of a real disaster.

The best tent for camping so far brought to the knowledge of the writer was of the kind known as the "squatter's." This had a fly sheet and two jointed poles. It was made of balloon silk, was very roomy when erected, was light, could be packed into a small compass, and yet was quite impervious to either wind or rain.

There are also tents to be had which can be used in conjunction with the car itself, and one has seen an outfit of this sort which allowed the car to be fitted with a couple of comfortable bunks for sleeping. The idea, however, does not commend itself for a permanent camp, excellent though it be for touring purposes. Any of the big stores can supply suitable tents for use with a car, and some also make

a speciality of camping gear, cooking utensils, etc.

If the camp is to be permanent it can be more elaborately fitted, naturally. For example, the tent, furniture, crockery, stove, etc., can be sent down to the nearest railway station by train, and collected by car. If the whole of the kit is to be carried by car, the question of packing is important. Everything should be disposed for accessibility, and the novice will find, unless he be particularly careful, that practically everything will need to be unloaded to reach some simple tool needed to carry out a tire repair, for example.

The Primus stoves which are now in such general use are excellent, but no food tastes so sweet as that cooked over a wood fire in the open. The experienced camper, also, can produce a fire more quickly than the stove can be lighted. Long experience, however, is needed to acquire proficiency in this art. Personally one does not recommend aluminium cooking and table utensils; the ordinary block-tin fittings which can be bought at any ironmonger's practically are much the best, though they do not pack so easily. The big stores sell much better complete outfits now than they did before the war, and possibly the novice had best leave himself in their hands in this respect, even though his preliminary outlay be heavier.

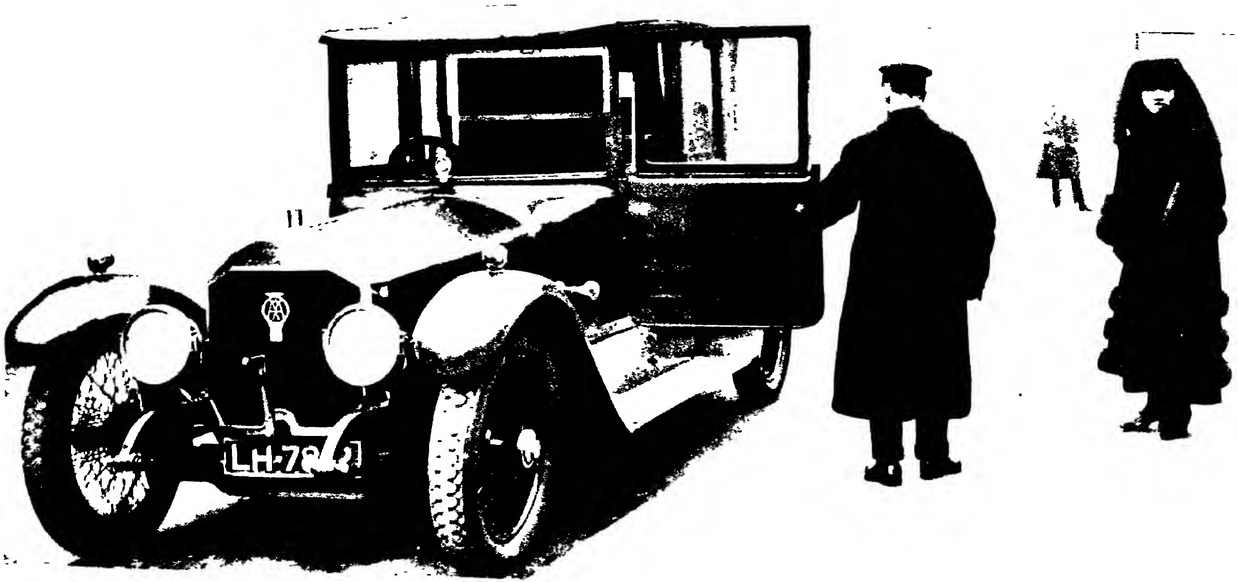
One of the most serviceable fittings consists of a long wooden box of plain deal to fit along the offside running board. Its appearance can be improved by painting it to match the body colour of the car, and its particular use is to carry those heavy and muddy or oily fittings that would be out of place amongst the food, crockery, or wearing apparel. In it can go towing chains—an indispensable accessory in case the car gets bogged—heavy jacks, stoves, paraffin oil, and the car's tool kit generally, the saving of space thus made being used for the accommodation of other fittings.

Another useful accessory for luggage carrying consists of a luggage trailer, which can be towed behind the car. These fittings follow the track of the car when in service, can be readily removed or attached, while they can readily take a load of up to a ton.

Most people have an idea as to their favourite locality, but in case of any uncertainty, especially about the sport or general facilities prevailing in any particular district, the motoring associations are always ready to give their advice, and, as that is obtained on the spot, it may safely be relied on.

Common sense is really the guiding rule in all camp life. For a small payment, but often enough without payment at all, permission can be obtained to camp in any desired place, particularly if the owner forms a favourable

impression of the applicant immediately. Experienced campers can hold high revelry for a month in one spot and, so far as appearance goes afterwards, it would be hard to tell that a camping party had been in possession. Others, of course, are careless and untidy; they destroy fences, burn valuable fuel when there is plenty of waste about, and leave a litter of paper, bottles, crockery, and tins behind them.



A [illegible] NAPIER CAR OWNED BY A FAMOUS ACTRESS

CHAPTER XXVII

THE CAR-THIEVING NUISANCE

THE scarcity of cars, coupled with the high prices now so easily obtainable for machines of any kind, is undoubtedly an encouragement to theft, while the decided hint of American methods about the whole business suggests that present conditions have attracted the attention of the professional car thief from across the Atlantic. No discourtesy is intended. The whole tribe must be as obnoxious to the Americans as to us, and without wishing this country ill in any way, the American and Canadian police would, no doubt, gladly make us a present of their car thieves.

The number of motors stolen in the various American States totals tens of thousands yearly, and although a great many are eventually recovered in a more or less damaged condition a big percentage are lost for good, some being broken up and sold piecemeal, and the remainder finding their way into the hands of owners who, unless they are in touch with the factory at some later date, never know that their car is

stolen property. There are signs that this country is also to be regarded as a profitable operating ground for the professional car thief, and combined and effective action is needed if the threatened danger is to be stamped out in its early stages.

In the first place the car manufacturer should impress the type and number of both chassis and engine more prominently than is usual on all the major components; this would be neither a complicated nor an expensive job. Attaching a small plate, giving the desired particulars, is obviously inadequate owing to the ease with which it may be removed, while numbers lightly stamped into the metal can be effaced without great difficulty.

With a good records system it is thus possible, providing buyers co-operate, to keep a close history of every chassis built. Rolls-Royce and De Dion, for example, have built up a good scheme along these lines which, in the common interest, should become general. Some three years ago, on the other hand, one discovered with amazement that one of the best-known of Northern manufacturers had such a poor records system, that the actual buyers of new cars could only be traced later with difficulty. Every car needs a general record and medical history sheet, which could be handed on throughout its effective life: a sort of pedigree, in fact. The buyer should protect

himself against dishonest dealing by getting into touch with the maker when purchasing a second-hand machine.

Various suggestions have been made in the U.S.A. and Canada that there should be a universal system of car licensing on a comprehensive scale. Something might be done here along these lines, particularly in view of the fact that our present system is quite out of date. The greatest objections are that we dislike the dossier system altogether, that we have no desire to increase the extent of official interference with our private affairs, that the number of State and municipal officials is already unduly large, and that the cost of the upkeep of the system would fall on the motorist. On the other hand there would be many advantages, and possibly the last item would be met by the saving of insurance policies. Let us, however, avoid such a system if we can, though in the end we may be driven to it. In the bigger American cities special departments have had to be set up by the police to prevent car thefts and to trace the machines after they are stolen. We do not want anything like this here.

Magistrates, it may be pointed out, are apt to take a lenient view of car thieving when the defence of "joy-riding" is advanced. This is quite indefensible. A sudden epidemic of parlourmaids—if such be still in existence—stealing their mistresses' rings to wear when

jazzing, innocent though the actual intention might be in the first place, would quickly be stopped by the imposition of drastic penalties. A similar course is needed in this matter of car stealing, so that the evil may be routed out before it gets any great hold.

The cases of motor thieving reported constantly increase in number, but up to date one has not yet come across any infallible safeguard. Various devices are being manufactured to check the thieves, but none, so far, seem able to prevent a skilful and determined man stealing any motor vehicle, given a suitable opportunity. I recently received an ingenious little appliance, which takes the form of a very simple ignition lock. So far as can be seen, without practical experience, the device should be quite serviceable. A quarter turn of a knurled ring throws the apparatus out of gear, hopelessly confusing the wiring, a special key of the Yale type being needed to reset the fitting to normal running position. Before a car fitted with this lock—the installation is simple enough—could be stolen the whole of the ignition wiring would need to be cut away and new cables installed. An additional precaution would be to fit both sides of the bonnet with locks. The ignition lock referred to is known as the Cowey, and although it is not perfect it is a safeguard under most conditions.

The American accessory makers have produced a variety of locks and devices designed to circumvent the car thief. Some are intended to have a universal application, while others are constructed for individual use. One appliance throws the steering-wheel out of gear, another affects the steering itself, either by holding the column itself or the steering arm, a third locks the brake and gear levers. There are ignition and fuel interrupters and cut-outs. Some fittings are to be mounted in the gearbox itself, to prevent the gears being moved out of neutral, and there are a dozen or more chains, steel ropes, cables, bumpers, alarm-bells, and other devices intended to delay the thieves in their work—but not a single one that is universal in its application, cheap, and effective under all conditions. The only absolute safeguard at the present time is for the owner never to leave the car unguarded. One must, however, put in a good word for the work of the Automobile Association, whose patrols are often valuable in tracing stolen cars.

The ideal safeguard would be readily accessible from the driving seat. It should not be of a type leading to a possibility of the car's mechanism being damaged in case of great force being used by the thief, nor should it need any special key or tool. It should be remembered, also, that although the ignition may be cut out, the fuel supply stopped, the

gears locked in neutral or the clutch locked out of engagement, the car can still be towed away. If a " delayed " guard, to come into operation after the engine or car is started, is fitted, some preliminary warning device should remind the owner in case of his own forgetfulness.

The removal of some small part, for which standardised renewals are readily obtainable, is not likely to deter the professional car thief. Few cars are stolen on the spur of the moment. The thieves work in a gang, and a car is carefully watched and its owner's habits noted for days beforehand. Further, a good theft-proof device should prevent a vehicle being stolen from a garage or taken out for unauthorised use. Makers should give some attention to fitting their cars with some kind of security device.

CHAPTER XXVIII

THE PRACTICAL USE OF BENZOL—A BRITISH MOTOR FUEL

EXPERIENCE proves that from many points of view benzol has distinct advantages over petrol as a fuel for car and motor-cycle engines. It is not perfect, but even a very average benzol is better than the so-called petrol with which motorists have of late been afflicted. Its characteristic pungent odour is objectionable to many, and the worse the benzol the viler the odour. Also, in cold weather, unless there is some means of warming the inlet-pipe, starting is difficult.

Better running altogether could be obtained by designing car engines especially for use with benzol. This, however, is a matter for the future; at present the average motorist is more interested in getting better results from existing car engines. Circumstances are in his favour. During the war poor quality motor spirit led car owners to use larger carburetter jets, with the consequence that benzol can now be used with fairly good results with a great

many modern carburetters without alteration. As it is slightly the heavier fuel, benzol gives a lower level in the float chamber; hence the supply to the engine is normally reduced.

Still, the best results are obtained by a little intelligent and simple adjustment. In the first place, the carburetter or the inlet-pipe must be heated, for a proper temperature of the inflowing gases is the secret of efficient combustion with all fuels. The best course is to have the carburetter fitted with a water-jacket or one of those easily fitted muffs which take their heat from the exhaust pipe. Heaters of the electric type, which take their current from a battery, can also be had. Heat having been supplied, actual comparative running results may be noted by road tests.

Take a typical carburetter setting for, say, a 16-h.p. Sunbeam car. Using a Zenith carburetter, the main jet for use with petrol would be 90, the compensator 105, and the choke 19. On a fair quality benzol it would probably be found that the main could be reduced to 85 and the compensator to 100, the choke remaining unaltered. In this way the fuel consumption should improve from twenty miles to the gallon on petrol to about twenty-two to twenty-three miles on benzol.

Speed on the level would be about the same, but there would be more power on hills. Further, the slower burning fuel decreases any

tendency to "knocking" in the engine. I am using an old car at present which gives a consumption of twenty-four miles to the gallon on petrol and twenty-eight on benzol. On the former fuel the engine knocks distressingly with the spark retarded as far as possible, yet on benzol it is practically impossible to obtain a knock even under a heavy load. The fitting of an efficient heating device has also led to better combustion and a perceptible improvement in the odour of the exhaust gases.

A word of warning should be given as to inferior benzols now on the market, which, contrarily enough, are sold at excessive prices. Such fuels have a bad effect on the engine bearings and other working parts owing to the presence of acids, alkalis, sulphuretted hydrogen, and other impurities; the exhaust odours are vile, and the power developed is unsatisfactory. Motorists should insist on being supplied only with benzol conforming to the National Benzol Association specification. This can now be obtained at 2*s*. 8*d*. per gallon practically throughout the country. More should not be paid. The best way to buy the fuel, however, is in fifty-gallon drums, which can easily be obtained, and may be stored without special licence.

The committee of the National Benzol Association have issued the following specification for benzol for use as motor spirit: (1) Specific

gravity, ·870 to ·885; (2) distillation test (by flask)—benzol shall give a distillate of not less than 75 per cent. to 80 per cent. at 100 deg. C.; (3) sulphur—the total sulphur shall not exceed 0·40 per cent.; (4) the benzol shall be entirely free from water; (5) colour—water white; (6) rectification test—90 c.c. of the sample shaken with 10 c.c. of 90 per cent. sulphuric acid for five mnutes should not give more than a light brown colour to the acid layer; (7) benzol shall be entirely free from acids, alkalis, and sulphuretted hydrogen; (8) benzol shall not freeze at 25 deg. F. below the freezing-point of water.

CHAPTER XXIX

HOLIDAYS IN THE CAR

In the days before the war an undue proportion of wealthy motorists crossed over to the Continent for holiday-making. During the height of the season between twenty and forty machines were shipped across the Channel daily, but despite the practical help of the motoring organisations, the cost was heavy and the inconvenience great. The number of private cars now going over to the Continent is growing as restrictions are removed, but the majority of the old-time Continental motorists are content, for this year at least—and, one hopes, for a long time ahead—to take their holidays at home.

There is motoring to be had in Great Britain to satisfy the greediest of drivers for a long time. Our roads, apart from the stretches spoiled by heavy commercial traffic and timber-hauling, are in fair condition, which is more than can be said for the Continental roads, although the French arteries, away from the fighting areas, are also in a passable state.

A little forethought is needed to get the best out of motor touring, which can be overdone as easily as most things. Staleness is recognised in other sports. The average week-end golfer, for example, who begins his summer holiday by putting in two full rounds a day, soon finds himself discontented and off his game. If he be a wise man he then indulges in a rest, yet there is a tendency on the part of motorists who are tired of the car to place the blame elsewhere. Speaking from experience, with the memory of many long, fast runs of over 300 miles between sunrise and sunset, I consider 125 miles quite enough for an average day's run, even with a powerful and roomy car, while a great many people will find 80 to 100 miles sufficient. Easy travelling ensures the possibility of maximum comfort. It excludes the early start, the "boiled-egg breakfast" in a half-swept coffee-room, the general atmosphere of being a nuisance, while fuel and oil for the full day's run may be taken aboard at the most convenient time. Further, there is an opportunity to look over the car herself, to give the greasers a turn, to inspect tyres and make replacements and adjustments. In the torrid days there is no fun in changing a wheel or tire in the broiling afternoon sun.

Running to a set programme rather detracts from the sense of freedom which many consider essential to a real holiday, but the lower daily

mileage is elastic enough to afford some compensation. In case of temporary delay, for example, the whole programme is not thrown out of gear, while there is also time to indulge in visiting any of the local excitements that may occur along the route. The country has not yet settled down, there are more holiday-makers than ever before, the food supply is a variable quantity, while practically every hotel is working with a depleted and tired staff; hence, to be on the safe side, it is advisable to split up long journeys into easy stages and to book rooms in advance. In most places of any importance it is possible to secure an odd room for the night, but more rooms, or an extended stay, are out of the question. The movements of the arranged guests, which do not always coincide, account for the chance of the odd room for the night; yet it is unwise to run any risks in this connection, for motoring can lose much of its fine savour when a tired and dinnerless party is compelled to drive twenty to forty miles on a questionable chance of securing accommodation in the next town.

The disposition of passengers, tools, and luggage is worth careful consideration. It is rather surprising that luggage trailers, of which there are some quite good specimens on the market, are not in more general use for touring. These attachments are constructed to follow the car wheel tracks. They are pneumatic-

tired, and not unduly prominent, while they will take up to a ton load. Indeed, they may be said to solve the luggage problem entirely, though their first cost, about £25 in pre-war days, must be considered. One may, of course, off-set this against the cost of special car trunks, cases, and luggage racks, but whereas the latter are useful throughout the year for shorter journeys, the trailer is rather a complication, if there is room in and about the car itself for small week-end luggage, for example.

The following lay-out for an open touring car may be suggested—luggage and trunks on a rack at the rear; spare wheel, two if possible, with an additional spare cover and tube—an advisable precaution owing to the difficulty most local agents have in getting supplies—on the offside running board and as far forward as possible; nested toolbox, with two different locks, and containing the complete kit for any operation the car may need, let into the nearside running board; spare petrol and lubricating oil also on the running board.

It is important that the engine should only be lubricated with the special oil prepared for it by the reputable oil companies, and recommended by the car builder. Proprietary oils in branded tins should be on sale in every garage, but some garage owners buy loose inferior oils

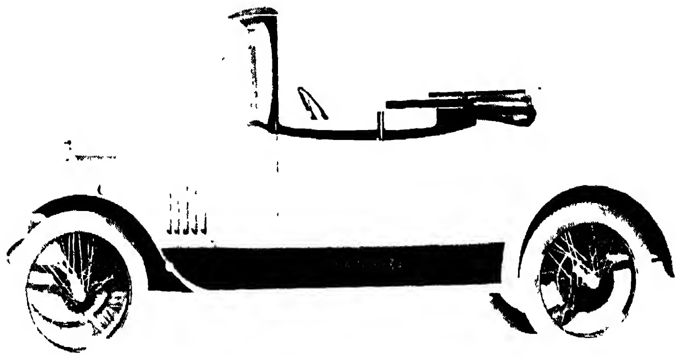
in bulk and press their sales for the sake of the extra profit thereby obtained. A gallon of the advised lubricant, therefore, should be taken along in case of difficulty in obtaining it *en route* ; spare lamp bulbs in a lined case, tire valves and parts, sparkling-plugs, and the more fragile replacements generally, in one of the lockers, preferably under the driving-seat; maps and guide books in the pocket to the right of the driving-seat.

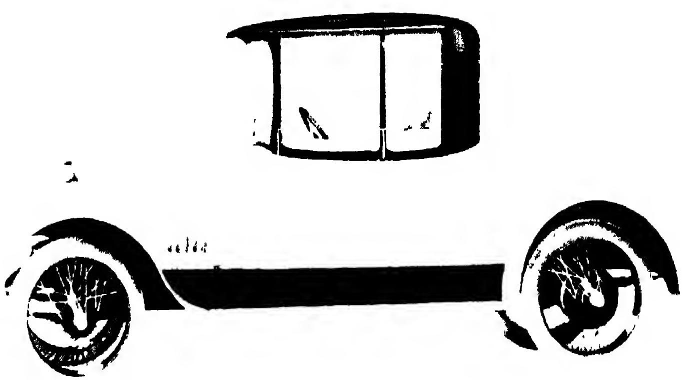
This arrangement makes all supplies accessible, yet keeps the interior of the car free for rugs and a dressing case. With closed cars the bulk of the luggage can be carried on the roof. The arrangement is not ideal, and a clever coach-builder with practical experience of car touring should be able to introduce many improvements, but at the moment one can only profitably deal with the cars already in commission.

If only for the information about the state of the roads, and the advice about touring which the Royal Automobile Club and the Automobile Association are both prepared to supply, it is well worth while taking up membership. In regard to their touring departments, both the R.A.C. and the A.A. and M.U. are highly to be recommended. Based on daily information sent in by their respective road men all over the country, the touring itineraries supplied are accurate and exhaustive, while they have

the additional merit of taking in country well worth visiting and leaving out the dull and dingy districts so far as possible. Members, in writing to the respective touring departments at 83, Pall Mall, or Fanum House, Whitcomb Street, should indicate the time at their disposal, and the particular districts they wish to include, together with other essential information, or, if their plans are not even so concrete as this, may simply ask for suggestions for a tour to extend over the time available. Both bodies will also give very valuable assistance about the insurance of the car, and also in regard to taxation and customs in cases where, despite the obvious difficulties, owners are determined on Continental travel.

So far as comfort on the road itself is concerned, it is a mistake to attempt too much. The rose-embowered country inn, with its loaded sideboards, its shining pewter, and its cool raftered passages, rarely happens to order, and, as mile after mile is covered in the search for it, driver and passengers get hungry and ever more hungry, and angrier and snappier, until at last, in sheer despair, an unappetising meal is taken in some fifth-rate hotel, where the poor food is only equalled by the superior charges. Great delay is also caused by chance driving to an hotel and asking for meals. The best course is to wire ahead to an hotel in the place where it is proposed to lunch when





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starting in the morning, reserving accommodation, or to telephone at least an hour or so before arrival. Here, again, the road men of the motoring bodies are of value to touring motorists.

CHAPTER XXX

BUYING SECOND-HAND CARS

PRACTICALLY all the buying and selling of motor cars during 1919 was limited to dealings in second-hand vehicles. Most people with any sense of values waited with whatever patience they could muster until new cars were to be had from the makers, but there were a great many others to whom cost was apparently a secondary matter, or else who were in the unfortunate position of having to buy even at an inflated price.

There is much unscrupulous dealing going on. No man with an atom of common sense in his make-up ought to buy a used car from a stranger on his own responsibility, especially if his mechanical knowledge is limited. He should take expert advice or write to the maker, giving a description of the chassis, with its number, and asking for whatever information is available about the machine. Unfortunately, many motor transactions are being rushed through without any preliminary investigation.

The most unsuitable cars to buy at any time

are those which are little known and those of foreign manufacture—most of the American makes, however, being excepted from this last ruling. The difficulty, of course, lies in obtaining spare parts. Unless these are in stock it is an expensive and lengthy job to have them specially made, and any buyer of a used car who is told that such and such a component is in need of renewal should, in his own interest, ascertain that the parts are actually available, or, better still, ask the would-be seller to have the adjustment made before the transaction is completed.

The average buyer of a second-hand car can only make quite a rough examination of the engine and chassis. Actually the former is better judged by its performance on the road than by examination, although, of course, an inspection should bring to light any glaring weakness. On the road the engine should be judged for quietness in running, speed of the car, hill-climbing power, and freedom from minor mechanical troubles. Towns are not suitable places to make tests, for a good driver can make quite a presentable showing for a little while with an old chassis in traffic. Nor is a run of ten miles sufficient to go by. A trial run should extend to between 50 to 100 miles, and should include a variety of country and conditions. The general condition of the transmission can be judged during the run.

Quietness is an important factor, of course, and although some very excellent cars always have noisy axles, it may be taken as a general rule that if the older types of cars are objectionably noisy they are not to be recommended. Broadly speaking, noise in nearly every case means wear. A very rough test of the steering can be made by removing the hands from the steering wheel and noting whether the vehicle leaves the straight track within too short a distance. The condition of the clutch and the brakes can also be judged in the course of the road trial.

Badly aligned wheels are, to say the least of it, undesirable. A very rough idea may be formed by noting the condition of the tires. Treads worn centrally and evenly are a fairly good indication that not very much is wrong with the alignment of the wheels. Each particular wheel should be jacked up in turn, and the wheel itself tested for side-play and wear in the bearings. A leaky radiator should be avoided, while the amount of use the car has really had can generally be seen by noting whether the clutch and accelerator pedals are badly worn.

Having bought a second-hand machine, one may as well extract as much comfort out of it as possible. In practically every case, although it is an expensive procedure, larger-sized tires can be fitted with advantage. The leaves of

the springs should be prized open and lubricant smeared in between, while the grease-retaining spring-gaiters, which can now be had in practically all sizes, are certainly well worth trying.

Shock-absorbers are well worth trying if the springs are noticeably harsh, as is often the case with old cars. Unless a second-hand car is a really good one, for which a high price has been paid, it is hardly worth while going to the expense of fitting an electric engine-starter; and, personally; one prefers acetylene lighting, especially where the gas is carried in cylinders, to electric lights, unless a dynamo is fitted to keep the accumulators charged. Whether it is advisable to fit detachable wheels, which are certainly a great convenience, is a matter that owners can best decide for themselves.

CHAPTER XXXI

CO-OPERATION IN BUILDING

THE education of motorists has been neglected in several ways. For example, the average owner hates the idea of scrapping a car. He may pay £500 for the machine in the first instance, and get five years of hard work out of it, but to sell for whatever the car will bring at the end of that time—regardless of the fact that the purchase price has been repaid in value several times over—is not a popular procedure.

Many owners like to think that their cars are built throughout in one works. Very few are, but so long as the makers do not advertise the fact users are quite satisfied. The system does not, however, give the best economic results. An enormous plant is needed before the major portion of any chassis can be built on an economic scale in one factory. There are certainly not more than half a dozen plants in the country which are fitted to produce a car practically throughout. This is an age of specialisation, and firms specialising in gear-

boxes, for example, can lay down specialised plant for constructing a thousand boxes weekly, while the individual concern that only needs a thousand boxes yearly for its own cars must make do with the nearest machines available. The car owner should be educated to the fact that every penny saved in the factory means lower costs to the purchaser.

There is no firm in this country at present that, "off its own bat," can build cars in tens of thousands yearly, but there is no reason why an intelligent combination of interests should not give the same results in practice. The component builders have evidently realised this fact. Dormans, of Stafford, to take only one case, are giving the whole of their energies to engine building. They have evolved a very complete range, and are prepared to construct thousands of engines yearly for any maker, either to special design or standard construction. Also, they are standardising the Dorman engines and putting them on sale at garages throughout the country, so that if an old chassis is to be reconstructed the garage-man can drop a standard unit into place without difficulty.

These engines may not be the last word in engine construction, but to my personal knowledge they are most excellent products. I will go further and say that they are better units, more cheaply built, sold at a lower price, and

with a better service system behind them, than the average individual engine which is, alas! too often not even interchangeable in its parts.

When motorists encourage makers to buy in the cheapest and best markets instead of trying work beyond their factory capacity car prices will begin to fall. Both American and French makers have organised combinations for buying, manufacturing, and selling purposes.

The Angus-Sanderson concern had never built a car before the war, but this year's programme calls for about 6,000 completed vehicles, which are to be sold at £450. Next year the company has in view 18,000 cars. It is claimed that under old-fashioned manufacturing methods it would have been impossible to have sold the car in pre-war days and prices for under £425.

This Angus-Sanderson car is none the less an individual car because it is an assembled unit. It represents the combined products of many trained brains. Specialists are responsible for every detail. To one the engine, to a second the frames, to a third the electric equipment, and so on. Each specialist had to satisfy those who were co-operating in the car's construction, as well as the sales agents.

As to the accuracy of the original plans, when the first completed cars came to be

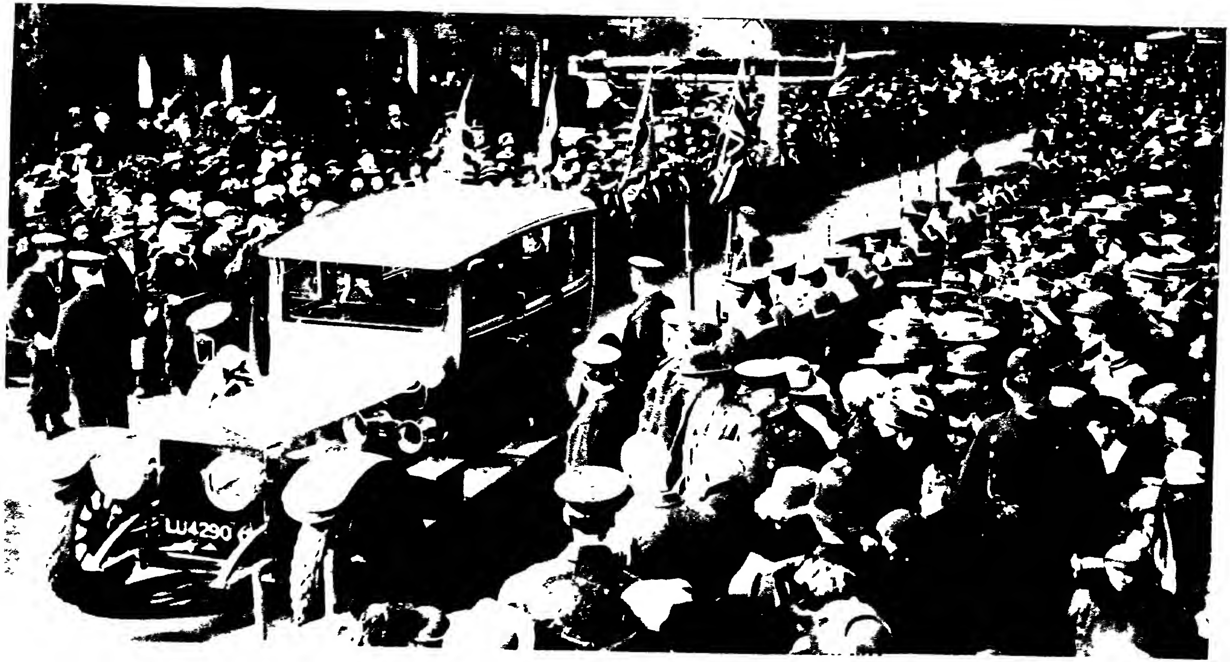


Photo Topical Press.

THE PRINCE OF WALES DRIVES HIS OWN ROLLS-ROYCE CAR

tested only two detailed changes—brakes and clutch-stop—were necessary. This can only be attributed to the fact that a dozen brains are better than one in car designing. A special car like the Rolls-Royce cannot, obviously, be produced by this method, but until every car is as good as the Rolls the majority could be reduced in cost if their makers took fuller advantage of the resources of specialist factories.

CHAPTER XXXII

THE COACHWORK OF THE NEW CARS

In dealing with the requirements of standard four and five-seated open touring cars, it is perhaps as well to examine the points which rendered past models so undesirable as compared to those of the present and the future.

Taking the question of comfort—this being undoubtedly the first consideration in cars intended for long journeys—we come first to the suspension and springing, upon which subject much ink has flowed.

It has been most peculiar to notice the various theories and methods tried and unnecessarily wasted on this subject in order to arrive at a satisfactory solution, when, had chassis makers only taken the trouble to examine the methods employed by their predecessors, the coach-builders, or consulted these authorities, the same conclusions would have inevitably been arrived at as are, according to many new designs, now developing.

The main principle underlying this is to consider the way in which the springs are to meet

the road shocks, and it must surely be admitted that the practices employed by many engineers in this respect were most amusing.

Without going too deeply into technical matters, the points are briefly as follows:

The car travelling in a forward direction, the springs should be slightly tilted up in front to meet the road shocks, as Fig. 1. Instead of this, when not horizontal the reverse was often actually the case, as in Fig. 2, with unsatisfactory results and the necessity for patent

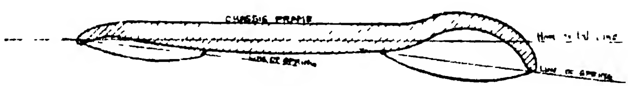


FIG 1

shock absorbers, etc., as past experience has proved.

One great proof of the above argument lies in the adoption of cantilever springs which are appearing on so many of the newer models.

This is going the whole hog with a vengeance, and is not really necessary, for the cantilever spring, although admittedly very comfortable, has its drawbacks in the way of increased rolling motion, and practically the same degree of comfort can be obtained by setting the springs as previously described in Fig. 1.

Leaving the question of suspension, we come next to the interior accommodation, and here we find another point in which the chassis designers erred—namely, the position of the pedals and steering wheel—this being also a very important matter when comfort in driving is considered.

The ideal position would seem to be as shown in Fig 3, where the lower part of the steering wheel rests in the angle formed by the thighs and trunk of the driver, whereas in many cases

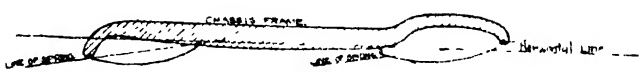


FIG 2

there was often not room even for a medium-sized person to get the knee under the wheel, and, in others, the column was so long as to throw the wheel up almost under the driver's chin. Again, others had the column elevated to such an angle as to be useless for other than high-seated landaulettes or limousines, or perhaps they only aspired to cabs.

These difficulties were largely accentuated by the fact that the slope of the steering column could not be changed to suit, but, again, this is a condition which is being met in some of the later designs, and should be pressed for

by the motoring public, for, although the need for adjustment is not so great in the standardised complete car, yet there are occasions when a slight adjustment of the column or pedals makes all the difference between comfort and discomfort in driving.

Again, we come to the motorist who wishes to buy the chassis and have his body built to suit his own requirements and ideas, for, in spite of the advantages in cost gained by production in quantities, there still remains a

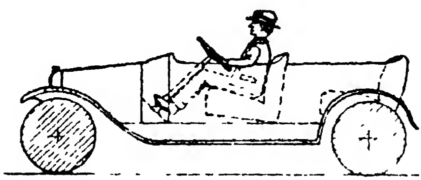


FIG. 3.

large class who, while preferring certain makes of chassis, do not like to be bound to accept something as like that of some one else as two peas in a pod.

Passing from this subject, we come next to the seats' upholstery; in which also a great improvement is noted in recent makes.

Taking, again, the driving seat, the slope of the cushion should be such as to afford support to the thighs, well forward to the knee, but should not be overdone so as to impede movement; similarly the slope of the back should

be suited accordingly, and the support given by the springs to accommodate both the top of the pelvis as well as the shoulder blades.

Many of these points are matters upon which opinion differs, but, apart from the special requirements of the few, it is the writer's experience that a happy medium can be arrived at which will accommodate the great majority, even including considerable diversity of build.

CHAPTER XXXIII

OLD-FASHIONED PLEASURE CARS

So few people are in possession of new cars now that motorists are, willy-nilly, forced to drive old-fashioned vehicles or go without altogether. It is hard to say whether it was the makers' constant improvement in design, or the public themselves, that led to so many new types of cars being made each year. Perhaps all these and other factors had a bearing on the matter. Whatever the reason, the fact was that anybody who was somebody in the days before the war would as soon have been seen smoking a pipe in Bond Street as driving in a car of last year's make.

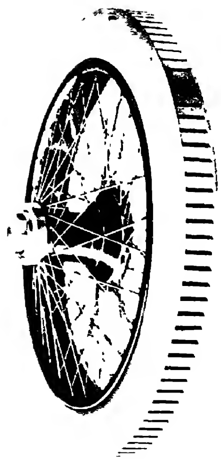
People are using old cars because they have no choice in the matter. Before the war the general tendency was towards a new car every year for those who could afford it. For the annual motor exhibitions the manufacturers set out to provide something new and startling, and although towards the end it became more and more difficult, and there were grounds for believing that many changes were made simply

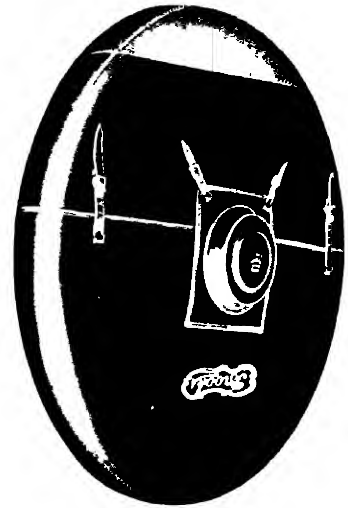
for change's sake, it was always possible to stage chassis and coachwork which, polished and shining under the blaze of light, and differing in detailed design from the models of the previous year, made even the unwilling agree that their own cars were shabby in comparison.

Naturally there are two sides to the question, and quite a good case can be made out for the yearly change. But the point now is that, without choice or by your leave, most people have to use old-fashioned cars or go without. The most curious thing about it is that the old crocks are standing up wonderfully well. Maybe they are a little noisier, a little slower on the hills, a little less pleasing to the eye schooled to the questionable artistic beauty of stream-lined coachwork, but, gallon for gallon of petrol and oil, there is so little difference between the car of 1915 and the car of ten years earlier by the same maker, that a fleeting doubt about whether the much-vaunted progress is real or not is not surprising.

It should be remembered, of course, that the older car has thousands of miles more work to its credit, and was sold in the first place for little more than half the price of its more modern relation.

There was an excellent car of 1914 which achieved and deserved popularity. Lightened by about 20 per cent. it would have repre-





sented the then high-water mark in car construction; the outward appearance was pleasing, the finish good, and the upholstering satisfactory; a four-cylindered engine, simple clutch, 3-speed gearbox, and a quite conventional back axle were the main constructional features; the petrol consumption was about twenty miles to the gallon, the top speed about forty-eight to fifty miles per hour, and the most comfortable touring speed about twenty-eight to thirty. The price was £350.

Ten years and more before 1914 the same maker built a single-cylindered car, with a disc clutch, 3-speed gearbox, and conventional back axle, that sold for just over £200. As things now are it was a heavy job throughout; the steering was by cable, the ignition by battery and coil, the gear-change of the straight-through type with lever and quadrant housed on the steering-wheel pillar, and the body was high and cumbersome.

Yet after fourteen years of work the car runs well. Petrol consumption is twenty-five to twenty-seven miles to the gallon, the speed on the level thirty to thirty-five miles per hour, on hills the car is admittedly slow and noisy.

On the other hand the ignition gives an easy start even with war spirit, and the control is simple. The query arises whether, after ten years' further experience and for the extra

£150, the 1914 type car is better or even equal value for money than the 1904 machine.

Actually there is no doubt in the minds of motorists, for if the two chassis were now built side by side and offered for the same prices as before there would be a dozen buyers of the £350 car to one of the £210. With cars, as with clothes, the world moves on and fashions change. Old clothes keep out the cold, but my lady will have none of them even in war-time; and old cars do their work, but my lord has the opinions of his friends to think of.

"I sell my cars," said the salesman of one of the most expensive machines in the world, "not to Dukes, but to those who like to be thought Dukes. The position of his Grace is assured in the eye of all men. He can afford to ride in a 'flivver'!"

There is some satisfaction, at any rate, in the fact that the old cars of British makers had so many years of work in them; they were sound and workmanlike jobs in the old workshop sense, and simply lacking in efficiency according to modern knowledge.

In this philosophy, those whose hope—about 75 per cent. of the whole—of a new car this year is doomed to disappointment may find comfort. Nor is there need for the maker himself to fear that the love of old cars may affect the market for the new; for in the first

place the present supply of either new or old cars is altogether inadequate, and when the new cars are actually available they will be bought because of a well understood natural law.

CHAPTER XXXIV

A SHORT CHAPTER ABOUT MOTOR-CYCLES

A GREAT many buyers were seriously perturbed during 1919 about the prices of motor-cycles. Before the war these machines afforded the most democratic of all kinds of motoring, and for that matter still do so, though they have temporarily passed out of the poor man's reach.

Looking backwards, one remembers what a wide range of application the inexpensive light-weight machines, which were rapidly passing out of the experimental stage, had at the beginning of the war. A sturdy, well-finished, two-stroke could be bought for £30; 80–100 miles to the gallon of petrol was quite an ordinary fuel consumption, while tires, lubricating oil, and other expenses were correspondingly low. The lightness of these machines and their handiness in traffic made them suitable for the use of the middle-aged man, the woman motor-cyclist, or the youngster whose means ran to nothing more expensive.

The light-weight could climb everything

but freak hills, it could reach a speed up to 45 m.p.h. on the level, and could take on a 1,000 miles tour at any time. The present price of the most popular two-stroke light-weight is over £43, and the small four-stroke machines of about the same power have increased in price in much the same proportion.

One of the reasons for this increase is to be found in extra mechanical refinement. The simplest and cheapest of all motor-cycles consists of a fixed engine having a simple belt drive, but a great many people rightly object to the inconveniences of a fixed engine, which necessitates starting the machine by pushing it along for a few yards and leaping into the saddle when the engine fires. On the other hand, the fitting of a free engine, and the addition of some form of speed gear, adds considerably to the cost; yet the refined motor-cycle appeals to many thousands of people who are not at all attracted by the more primitive constructions.

Taking everything into consideration, we are now in very much the same motor-cycling position as before the war, for, while wages are higher, the first and maintenance costs of motor-cycles are also proportionately greater.

The same observations in regard to the increased prices of light-weight cycles apply with equal force to the more powerful machines. Five years ago a really good 3½ h.p. motor-

cycle could be bought for between £45 and £60; nowadays a machine of similar power averages between £80 and £95. The cheapest $3\frac{1}{2}$ h.p. motor-cycle now advertised is an extremely simple machine at £63; while the most expensive costs over £96.

The $3\frac{1}{2}$ h.p. single-cylinder machine will take a passenger and luggage, especially if it is fitted with some form of speed-gear, but the modern tendency is towards more powerful "twin" engines, which have a little in reserve for the sudden call. These engines are better balanced, but the present cost of the more powerful machines is almost painfully high—£100 is a usual sum, and £120 not unheard of; a side-car costing £30 brings the total price to £150, an astonishing figure for a motor-cycle outfit. Nor is there any immediate relief for buyers in the second-hand market. At the auction sales of used Army machines bids of between £100 and £140 for side-car outfits are common.

Of course, there is a reason. Here it is the old economic law of supply and demand—the latter, for once, largely predominating. I have been taken to task for undue optimism in suggesting that present prices are greatly inflated, and that they will, in the not very distant future, be reduced. Yet, looking at the matter in the strict commercial sense, it seems that if we cannot lower the present

prices, an extremely valuable trade must be lost, and makers are not fools.

Prices this year can hardly be reduced, because the finished product is always considerably behind the raw material market. Motor-cycles for 1919 must also bear a considerable sum per machine for experimental and overhead charges. The figure will be higher than usual on this year's working, because not a great many machines will be built, and those few will be manufactured under the most unfavourable conditions in regard to raw material and labour. Next year, however, the factories will be in full swing, wages will not be lower, but output should be much greater—given that the Labour world sees the matter in the right light.

Raw material prices also should be lower, while there should not be the same heavy charges for experimental work and special tools. A further saving can be made by simplifying design, without, however, sacrificing refinement. Courage and originality on the designer's part are the necessary qualities.

CHAPTER XXXV

The Cars of 1920—In Alphabetical Tabular Form

SPECIALLY PREPARED BY JOHN ARMSTRONG

The following is an extensive alphabetical index-guide to most of the new cars—large and small, on three wheels and four—which are promised for the ensuing season. It has been arranged so that the important features distinguishing each chassis can be gauged at a glance.

In view of the restless phase through which the labour world is at present passing, some manufacturers are even now unsettled in the finality of their movements and programmes. On the whole, however, The Car Buyer's Guide will be found useful, highly accurate, and almost exhaustive in the quantity of its contents.

A.B.C. Walton Motors, Ld., Walton, Surrey.

Eight h.p. horizontal opposed twin-cylinder (92 × 92 mm.) air-cooled engine. Four forward speeds, disc clutch, live

axle, and "coster-barrow" type suspension, with 710 × 90 mm. wire wheels. Wheelbase 8 ft. 6 in., gauge 4 ft. 0 in., weight 7½ cwt. Electric lighting set.

100 h.p. five-cylinder unjacketed radial overhead valve engine mounted on a gimbal bearing. Four speeds, through crypto gearing in fly-wheel. Hinged live axle, double drive by independent bevel gears; cone brakes. Aeroplane type tubular chassis.

A.C. Auto-Carriers, Ld., Thames Ditton, Surrey.

Four-cylinder water-cooled (66 × 109 mm.) monobloc motor, 10 h.p.. Zenith carburetter, improved clutch and brake system, three speeds, overhead worm-driven live axle, one-piece U-shape frame. Wheelbase 8 ft. 6½ in., 3 ft. 10 in. gauge, 710 × 90 disc wheels, weight 12½ cwt.

"Bantam" horizontal opposed twin-cylinder 8 h.p. engine, cardan shaft drive.

ALBERT. Adam, Grimaldi & Co., Ld., London, S.W.

Twelve h.p. four-cylinder water-cooled monobloc (68 × 103 mm.) engine, with valves in head, and fabric disc clutch. Four forward speeds to live axle; quarter-elliptical suspension, electric starting and lighting outfit. Wheelbase 9 ft. 2 in., track 4 ft. 1 in., 710 × 90 artillery wheels; weight with body 12½ cwt.

ALLDAYS-ENFIELD. Alldays and Onions Pneu. Engineering Co., Ld.. Birmingham.

Ten h.p. (63 × 80 mm.) five-cylinder air-cooled radial engine, superimposed hollow mushroom, slide-poppet type overhead valves, multi-disc clutch, three speeds. Pressed steel Delta-shaped frame, cantilever springs all round; 810 × 90 tires, with removable wheels. Wheelbase 8 ft. 6 in., 4 ft. track. Adjustable steering column and hinged hand-wheel. Enclosed cardan shaft to helical bevel gear in back axle, which has fabric-faced expanding ring brakes. A single universal joint and fabric-covered cone running brake.

Fifteen h.p. six-cylinder (70 × 110 mm.) engine, separate vertical cylinders, valves as in 10 h.p. model. Pumped water cooling and lubrication. Electric starting and lighting equipment. One-plate clutch, four forward speeds, encased cardan shaft, and helical bevel gear in live axle. Steering gear as in 10 h.p. chassis ; pressed steel frame, wire disc 320 × 120 wheels; wheelbase 9 ft. 9 in., 4 ft. 4½ in. gauge.

ANDERSON (U.S.A.). H. C. Motor Co., Ld., 88, Great Portland Street, W.1.

Twenty h.p. (3¼ × 4½ in.) Continental bloc six-cylinder motor, united with gear-box. Centrifugal pump water circulation, plunger pump and splash lubrication, Zenith carburetter, and Bosch starting motor independent of lighting dynamo. Three forward speeds, internal and external brakes on driving wheels. Pressed steel live axle case, semi-elliptic springs, 33 in. × 4 in. wheels, 10 ft. 6 in. wheelbase. Has a convertible body with exceptionally neat concealed rear seat.

ANGUS SANDERSON. Sir Wm. Angus, Anderson & Co., Ld. Birtley, Durham.

Dorman 14 h.p. four-cylinder monobloc 3 in. × 5 in. engine. Electric starting and lighting equipment; thermal water-cooling, plunger pump lubrication, cone clutch, three forward speeds, with central gate-change and brake levers, banjo-type bevel-geared live axle by Wrigley. Motor and gears a unit, brakes in bask wheels, single-joint enclosed cardan shaft. Cantilever rear springs, steel disc 815 × 105 wheels; 10 ft. wheelbase, 4 ft. 4 in. gauge, full weight 20 cwt.

APPERSON (U.S.A.).

Thirty h.p. eight-cylinder (V-blocks, 83 × 127 mm.) engine, single disc clutch three forward speeds, half-elliptic front and ¾-eliptic rear underslung suspension.

Wire wheels, 10 ft. 10 in. wheelbase, electric starting and lighting plant.

ARMSTRONG-SIDDELEY. Siddeley Deasy Motor Co., Ld., Coventry.

Twenty-nine h.p. six-cylinder ($3\frac{1}{2} \times 5\frac{1}{4}$ in.) engine, overhead valves. Electric starting and lighting outfit. Disc clutch, three forward speeds, double-jointed cardan shaft, helical bevel-geared live axle. Central gear-shift, and tripod engine support. Brakes in back disc wheels.

ARROL-JOHNSTON. Arrol-Johnston, Ld., Dumfries, N.B.

Four-cylinder (75 × 150 mm.) "13–30" h.p. bloc motor, with removable crown and overhead valves. Pump oiling and water circulation systems, with special means for chassis lubrication. Fabric cone clutch, four forward speeds, central gate-change, and helical bevel gear in live axle. Enclosed single-jointed propeller-shaft; large-diameter expanding ribbed-drum; brakes behind gear-box and in back wheels. Improved principle of lubricating front encased (semi-elliptic) and rear (cantilever) springs. Incranked and upswept frame; removable 815 × 105 mm. steel artillery wheels, 10 ft. wheelbase, 4 ft. 8 in. track, weight complete 1 ton.

ASHTON EVANS. Ashton Evans Motor Co., Ld., Liverpool.

Four-cylinder (64 × 85 mm.) 10 h.p. water-cooled engine in front. Cone clutch, three forward speeds, live axle "twin"-rear wheel drive, wheelbase 8 ft., gauge 3 ft. 10 in. 710 × 80 mm. disc wheels, two-seat body.

ASHTON-MARTIN. Martin, Bamford & Co., 3, Callow Street, S.W.

Four-cylinder 12 h.p. water-cooled engine, three forward speeds, bevel-driven axle, steel artillery wheels.

AUSTIN. Austin Motor Co., Ld., Northfield, Birmingham.

Four-cylinder 20 h.p. (95 × 127 mm.) monobloc motor, with removable crownpiece. Single disc Ferodo clutch, four forward speeds, helical bevel gear in back axle. Removable artillery wheels, semi-elliptical underslung suspension. Unit engine and gear system; electric starting and lighting apparatus; vacuum fuel feed, and thermal water circulation. Wheelbase 10 ft. 9 in.

AUTOCRAT. Autocrat Light Car Co., Ld., Birmingham.

Eleven h.p. four-cylinder (69 × 100 mm.) bloc motor, forced and splashed lubrication, thermal water circulation, Zenith carburetter, multi-disc clutch, three forward speeds, live axle drive. Wheelbase 9 ft., track 4 ft., 760 × 90 metal artillery wheels. Electric lighter and starter, brakes in rear hubs, roller bearings.

BAYARD-CLEMENT (France). Bayard Cars, Ltd., 155–7, Great Portland Street, London, W.

Four-cylinder (60 × 100 mm.) 8 h.p. ball-bearing monobloc motor, three forward speeds, semi-floating live axle drive. Leather cone clutch, thermal water-cooling, lighting dynamo, half-elliptical suspension.

Four-cylinder (70 × 130 mm.) 12 h.p. monobloc engine, four speeds, live axle, electric starter and lighter.

Four-cylinder (80 × 140 mm.) 15 h.p. monobloc engine, multi-disc clutch, four speeds, live axle. Electric starting and lighting. Cardan shaft with steel ring universal joints at both ends, all brakes in back wheels, but in centre thereof, and not at the side, as usual.

BEAN. Harper, Sons and Bean, Ld., Dudley, Worcs.

Four-cylinder (69 × 120 mm.) 11 h.p. monobloc engine, conical clutch, three forward speeds, live axle, semi-elliptic suspension. Electric starter and lighter. 760 × 90 mm. wheels, wheelbase 8 ft. 6 in., gauge 4 ft. 1 in., weight 17 cwt. This chassis is an improved model of the four-cylinder Perrycar, now no longer constructed.

BELSIZE. Belsize Motor Co., Ld., Clayton, Manchester.

Four-cylinder (90 × 110 mm.) 15 h.p. engine, metal cone clutch, four forward gears. Magneto ignition, automatic carburetter, with vacuum fuel feed, thermal water-cooling through large radiator. Finger control-lever coupled to pedal accelerator. Steel artillery 815 × 105 mm. wheels; 9 ft. 8 in. wheelbase, 4 ft. 4 in. gauge.

BENTLEY. Bentley and Bentley, Hanover Square, W.1.

Four-cylinder (69 × 120 mm.) 11 h.p. bloc motor, with aerolite pistons, and double inlet and exhaust valves in each cylinder-head. Conical clutch, and four forward speeds. Electric starting and lighting outfit. Wheels 820 × 120 mm., wheelbase 9 ft. 4 in., track 4 ft. 8 in.

BERLIET (France). L. C. Rawlence & Co., Ld., 40, Sackville Street, W.1.

Four-cylinder 70 × 130 mm. monobloc motor, removable head, disc clutch, three forward speeds, helical bevel live axle. Gears and engine a unit, with central gear-shift. Pressure lubrication, pump water cooling, H.T. magneto ignition apparatus, and combined starting motor and lighting dynamo. Front level rear springs and disc wheels with removable rims.

BIANCHI (Italy). Bianchi Motors, Ld., St. James's Street, S.W.1.

Four-cylinder (75 × 120) 14 h.p. monobloc motor, multi-disc clutch, four forward speeds, bevel gear live axle drive. Forced lubrication and water-cooling. 820 × 120 mm. wire wheels, wheelbase 10 ft. 2 in., gauge 4 ft. 0 in.

BRASIER (France). Brasier Société des Automobiles, 77–8, High Street, Marylebone, London, W.

Four-cylinder (85 × 150 mm.) 17 h.p. bloc motor, conical clutch, four forward speeds, semi-elliptical suspension, electric starting and lighting apparatus. Wheelbase 10 ft. 10 in., 4 ft. 7 in. gauge, wire wheels.

Briscoe (U.S.A.).

Four-cylinder (79 × 130 mm., 24 h.p. monobloc engine, with removable crown. Dry disc clutch, three forward speeds, live axle bevel drive, whole-elliptical spring suspension, electric starting and lighting outfit.

Briton. Briton Motor Co., Ld., Wolverhampton.

Four-cylinder (60 × 110 mm.) 10 h.p. monobloc engine, Zenith carburetter, thermal cooling, leather cone clutch, three forward speeds, worm-driven live axle, 700 × 85 mm., artillery wheels, 8 ft. 10 in. wheelbase, 4 ft. 5 in. track.

Another model, four-cylinder (90 × 120 mm.) pair-cast cylinders, bevel drive.

B.S.A. Birmingham Small Arms Co., Ld., Birmingham.

Four-cylinder (75 × 114 mm.) 13 h.p. double sleeve-valve engine, leather cone clutch, three forward speeds, worm drive, 810 × 90 mm. wire wheels, front and rear cross-spring suspension, wheelbase 9 ft. 4 in., track 4 ft. 8 in.

Buchet (France). Buchet and General Car Agency, Ld., 69, Drayton Gardens, London, S.W.

Four-cylinder (76 × 130 mm.) 12 h.p. monobloc motor, cone clutch, four forward speeds, bevel-driven live axle.

Buick (U.S.A.). General Motors (Europe), Ld., Long Acre, W.C.1.

Six-cylinder (85 × 114 mm.) 28 h.p. monobloc motor, with overhead valving. Forced lubrication and water-cooling, fabric plate clutch, three forward speeds, electric starting and lighting unit. Cantilever back springs, 875 × 105 mm. wheels with movable rims, 9 ft. 10 in. wheelbase.

Cadillac (U.S.A.). F. S. Bennett, Ld., 24–27, Orchard Street, London, W.

Eight-cylinder ($3\frac{1}{8} \times 5\frac{1}{8}$ in.) 20 h.p. V engine, three forward speeds, spiral bevel drive in live axle, electric starting

and lighting equipment, pump cooling, Delco ignition apparatus.

CALCOTT. Calcott Bros., Ld., Coventry.

Four-cylinder (65 × 110 mm.) 10 h.p. monobloc motor, three forward speeds, bevel-geared live axle, semi-elliptical suspension, 700 × 80 mm. artillery wheels. Leather cone clutch, variable firing magneto, wheelbase 7 ft. 6 in., 3 ft. 9 in. gauge.

CALTHORPE. Calthorpe Motor Co., Ld., Bordesley, Birmingham.

Four-cylinder (65 × 95 mm.) 10 h.p. bloc engine, Hele-Shaw multi-disc clutch, three forward speeds, bevel-driven live axle, Brolt electric starting and lighting outfit, detachable 710 × 85 mm. Sankey disc wheels, wheelbase 8 ft. 3 in., track 3 ft. 8¾ in. Semi-elliptical encased spring suspension, single annular ring leather universal joint, tube-enclosed cardan shaft. Annular ring joint (leather) between clutch and gear-box. Zenith carburetter, and M.-L. magneto.

CARRICK.

Four-cylinder (76 × 150 mm.) 20 h.p. monobloc motor, cone clutch, cardan shaft direct drive to bevel live axle. 810 × 90 mm. detachable steel disc wheels, wheelbase 10 ft. 6 in., 4 ft. 8 in. track, semi-elliptical underslung suspension.

CASTLE. Castle Motor Co., Ld., Kidderminster.

Four-cylinder (64 × 85 mm.) 10 h.p. Dorman engine, two-speed epicyclic gear. Three wheels 8 ft. 3 in., wheelbase 4 ft. 1 in. gauge. Dynamo lighting set. Weight 9 cwt. Quarter-elliptic front and semi-elliptic rear suspension.

CHALMERS (U.S.A.). Maxwell Motor Co., Ld., Great Portland St., W.1.

Six-cylinder (82 × 104 mm.) 25 h.p. monobloc motor, with detachable head and united gear-box. Vacuum

petrol feed, Stromberg carburetter, "hot-spot" intake and exhaust manifold piping, multi-disc, Raybestos-faced clutch, three forward speeds, spiral bevel disc axle, pressed steel "banjo" live axle casing. Both brakes in rear wheels, separate dynamo and electric starter. Semi-elliptic suspension, wheelbase 9 ft. 9 in (also 10 ft. 2 in.), 32 in. × 4 in. wheels.

CHANDLER (U.S.A.). H. G. Burford & Co., Ld., 16, Regent Street, W.1.

Six-cylinder (89 × 127 mm.) 29 h.p., triple-cast cylinders, three-bearing crankshaft, pump water circulation, multi-disc clutch, three forward speeds, full floating helical bevel live axle. Stewart vacuum fuel feed, Bosch magneto, electric starting and lighting outfit. Semi-elliptic suspension, 34 in. × 4 in. detachable wire wheels, 10 ft. 3 in. wheelbase.

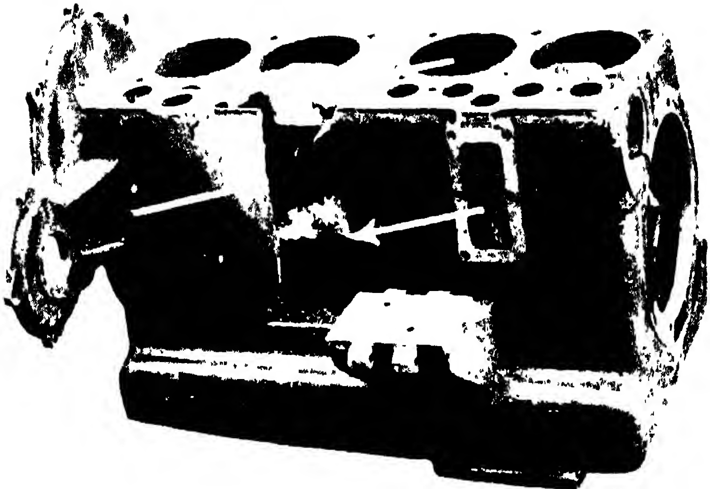
CHARRON-LAYCOCK. Charron-Laycock Motor Co., Ld, Sheffield.

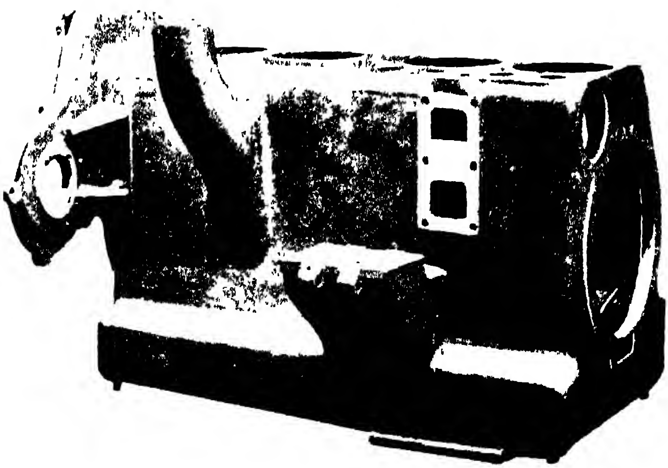
Four-cylinder (63 × 110 mm.) 9 h.p. bloc engine; removable head, forced lubrication, three forward speeds, helical bevel-geared live axle, vacuum fuel feed.

Four-cylinder (83 × 140 mm.) 17 h.p. motor *en bloc*, having detachable cylinder-crown, and being united with gear-box (four forward speeds). Magneto ignition, with lighting dynamo and starting motor; horizontal carburetter, and vacuum petrol feed system. Both brakes in back hubs. Single-jointed enclosed cardan shaft to one-piece banjo rear axle casing, final driving gear being easily withdrawn. Cantilever rear springs underslung; removable 820 × 120 m.m. wire wheels.

CHENARD-WALCKER (France). Chenard and Walcker, Rue du Moulin de la Tour, Genevilliers, Seine, France.

Four-cylinder (70 × 130 mm.) 10 h.p., and 15 h.p. (80 × 150 mm.) motors. Both chassis have conical clutches, four forward speeds, Chenard-Walcker type gear-driven





live axle, semi-elliptic spring suspension, and electric starting-lighting apparatus.

CHILTERN. Wardman and Fitch, 166, Great Portland Street, W.1.

Dorman four-cylinder (69 × 120 mm.) 12 h.p engine, Ferodo plate clutch, four forward speeds, bevel drive, brakes in back wheels (760 × 90 mm.), and gear lever on lid of its box. Cantilever rear springs, Smith dynamo and lighting equipment, single ring universal joint between clutch and gear box. Wheelbase 9 ft., track 4 ft.

CLEMENT-TALBOT. Clement-Talbot, Ld., Barlby Road, W.10.

Four-cylinder 12 h.p. (80 × 120 mm.), 25 h.p. (101 × 140 mm.) and six-cylinder (80 × 130 mm.) 36 h.p. engines. Features common to all chassis are: enclosed valves, forced water circulation and pressure-fed lubrication at 15 lb. per sq. in. Four forward speeds, bevel-driven live axle, removable artillery steel wheels.

COLUMBIA (U.S.A.). Stanley J. Watson, 37, Sheen Road, Richmond, London.

Six-cylinder 30 h.p. engine, three speeds, live axle, cantilever gear suspension, with special recoil device.

COSMOS. Cosmos Eng. Co., Ld., Fishponds, Bristol.

Triple-cylinder (80 × 75 mm.) radial, unjacketed, motor, with aluminium cylinder-crowns containing the valves. Disc dry clutch, three forward speeds, live axle. Special ignition apparatus and electric lighting. Wheelbase 7 ft. 6 in., track 3 ft. 10 in., 700 × 80 mm. disc wheels; weight approximately 6 cwt.

COVENTRY-PREMIER. Coventry Premier, Ld., Coventry.

Two-cylinder V-type 8 h.p. water-cooled motor in front under bonnet, three forward speeds, shaft and encased

chain drive, three 700 × 80 mm. wheels; electric lighting; two-seated body.

CROSSLEY. Crossley Motors, Ld., Gorton, Manchester.

Four-cylinder (102 × 140 mm.) 25 h.p. pair-cast motor, pump water-cooling, Smith carburetter, Ferodo aluminium cone clutch, four forward speeds, helical bevel gear live axle. Vacuum fuel feed, electric starting and lighting mechanism, underslung ¾-elliptic rear springs. Five-bearings to crank-shaft, aluminium pistons, and chain-driven valve-shaft. Running brake behind gear-box, single joint at front end of enclosed cardan shaft, ball and roller bearings for the gears. Rudge-Whitworth removable wire wheels, wheelbase 11 ft. 3 in., gauge 4 ft. 6 in.

CUBITT. Cubitt Engineering Co., Ld., Gray's Inn Road, W.C.

Four-cylinder (80 × 140 mm.) 16-20 h.p. bloc motor, inverted cone clutch, four forward speeds, bevel-geared live axle, accumulator and coil ignition apparatus, electric starting and lighting. Semi-elliptical suspension, 815 × 105 mm. disc wheels, wheelbase 10 ft. 6 in., track 4 ft. 6¼ in.

DAIMLER. Daimler Co., Ld., Coventry.

Six-cylinder (90 × 130 mm.) 30 h.p. and 45 h.p. (110 × 130 mm.) double sleeve-valve engines. Both chassis furnished with leather cone clutch, four forward speeds, worm-driven live axle, and cantilever rear suspension.

DARRACQ (France). Darracq Motor Engineering Co., Ld., Townmead Road, Fulham.

Eight-cylinder (75 × 130 mm.) 30 h.p. V engine, disc dry clutch, Smith four-jet carburetter, four-speed gear

unit with motor crank-case, Gleason spiral-bevel live axle. Forced lubrication by gear pump, chain-driven valve shaft. Delco system of ignition, starting and car-lighting without use of a magneto. One-piece steel banjo-type live axle case; steering gear mounted on motor casing. Frame of wide section; semi-elliptic front and cantilever back springs. Michelin steel disc or detachable wire wheels, wheelbase 11 ft. 6 in., track 4 ft. 5 in.

DAWSON. Dawson Car Co., Ld., Coventry.

Four-cylinder (69 × 120 mm.) 11 h.p. monobloc thermal-cooled motor, with overhead inverted trumpet valves without tappets, removable crown-piece, offset crank-shaft, and Ferodo-lined cone clutch. Pump-fed trough lubrication, Zenith carburetter, M.-L. magneto. Three forward speeds, double fabric-jointed cardan shaft, helical bevel-geared live axle. Semi-elliptic suspension, 710 × 90 Sankey steel wheels, electric starting and lighting.

DAY-LEEDS. Job Day and Sons, Ld., Leeds.

Four-cylinder (64 × 100 mm.) 10 h.p. monobloc motor, leather cone clutch, three forward speeds, bevel-geared live axle, steel artillery 700 × 80 mm. wheels, wheelbase 7 ft. 9 in., track 3 ft. 9 in.

DE DION-BOUTON (France). Ancas. Étabs. de Dion et Bouton, Puteaux, Paris.

Four-cylinder (70 × 120 mm.) monobloc engine (12 h.p.), as a unit with single disc fabric-faced clutch, four speeds, bevel-driven live axle, wheelbase 9 ft. 6 in., track 4 ft. 0 in., 760 × 90 mm. detachable disc wheels, rear cantilever suspension.

Four-cylinder (70 × 110 mm.) 12 h.p. engine, with single plate clutch and four-speed gear-box as a unit having operating levers mounted directly thereon. De Dion-Bouton magneto ignition, electric starting and lighting outfit, cantilever rear suspension, 760 × 90 mm. removable artillery or Michelin disc wheels.

Eight-cylinder (60 × 100 mm.) 14 h.p. chassis, with semi-elliptic suspension, otherwise similar to 12 h.p. model.

Four-cylinder (85 × 130 mm.) 18 h.p. chassis, otherwise similar to 14 h.p. model.

Eight-cylinder (70 × 120 mm.) 20 h.p. chassis corresponding to that of the 18 h.p. type.

DEEMSTER. Ogston Motor Co., Ld., Oakfield Road, Acton, W.3.

Four-cylinder (62 × 90 mm.) motor *en bloc*, conical clutch, three forward speeds, and mechanical starter. Wheelbase 7 ft. 8 in., gauge 4 ft., 710 × 85 mm. wheels, quarter-elliptical back suspension.

DELAGE (France). L. Delage et Cie, 138, Boulevard de Verdun, Courbevoie, Seine, France.

Six-cylinder (80 × 150 mm.) 24 h.p. monobloc motor, multi-disc clutch and four-speed gear-box as a unit. Four bearing crank-shaft, spiral bevel live axle, double-jointed cardan shaft, front and rear wheel brakes, and gear-shaft brake. Two Zenith horizontal carburetters, pump-fed oil and water circulation system.

DELAUNAY-BELLEVILLE (France). Delaunay-Belleville (England), Ld., Cricklewood, N.W.

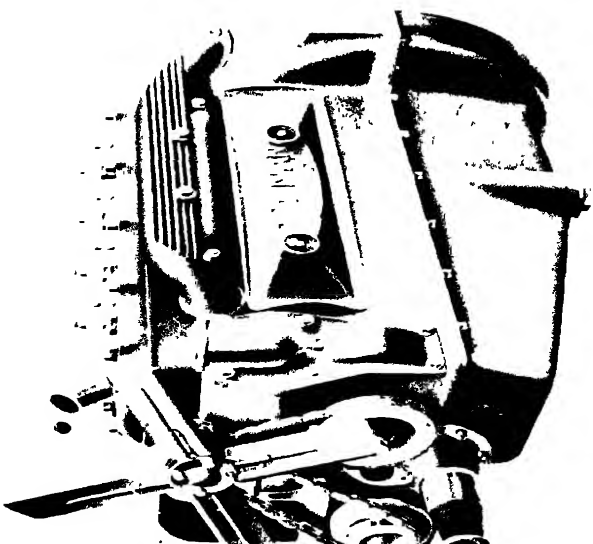
Four-cylinder (85 × 130 mm.) 17 h.p., and 25 h.p. (100 × 140 mm.).

Six-cylinder (78 × 140 mm.) 20 h.p., 30 h.p. (88 × 150 mm.), 45 h.p. (103 × 160 mm.).

All chassis have multi-disc clutch (except 17 h.p. type, which has conical clutch), four forward speeds, and bevel-geared live axle.

D.F.P. (France). Doriot, Flandrin et Parant, Paris.

Four-cylinder (70 × 130 mm.) motor, and four-speed gear-box. Electrical starting and lighting equipment, cantilever suspension, artillery wheels.



D.L. D.L. Motor Manufacturing Co., Ld., Motherwell, N.B.

Four-cylinder (68 × 90 mm.) bloc motor, Zenith carburetter, cone clutch, three forward speeds, bevel-geared live axle, wire or steel artillery wheels, wheelbase 8 ft. 6 in., gauge 4 ft.

DODGE (U.S.A.). Dodge Bros., Detroit, Mich.

Four-cylinder (98 × 114 mm.) 17 h.p. monobloc motor, having removable crown and multi-disc clutch, three forward speeds, bevel-geared live axle, ¾-elliptic rear suspension, wheelbase 9 ft. 6 in., 4 ft. 8 in. gauge, 32 in. × 3½ in. removable rims artillery wheels. Engine and gear unit system, with central gear and brake levers, Eisemann magneto, Stewart carburetter, centrifugal water and oil pumps, North-East single unit starting- ghting outfit, internal and external brakes in back wheel drums.

DORT (U.S.A.). Whiting, Ld., 334, Euston Road, N.W.1.

Four-cylinder (89 × 127 mm.) 15 h.p. bloc motor, conical clutch, three forward speeds, bevel-geared live axle, cantilever rear suspension, 30 in. × 3½ in. artillery wheels.

DOUGLAS. Douglas Bros., Ld., Kingswood, Bristol.

Two-cylinder (92 × 92 mm.) 10 h.p. horizontal opposed engine, cone clutch and three forward speeds wheels 700 × 80 mm., spiral spring-and-level back axle suspension system.

DUPLEX. British Commercial Lorry and Engineering Co., Ld., 66, Bridge Street, Manchester.

Eight-cylinder (56 × 75 mm.) 10 h.p., bloc-cast motor, each cylinder having an internal sleeve valve and pistons with articulated connecting rods to a single four-throw crank-shaft. Fabric-faced cone clutch, three-speed gear-

box, with central gear-shift, and united to the engine crank-case. Enclosed cardan shaft, with single-fabric joint to bevel-geared live axle. Mechanical engine-starting device. Thermal water-cooling and plunger-pump oiling. Dynamo lighting set. Removable steel disc 710 × 90 mm. wheels, 8 ft. 6 in. wheelbase, 4 ft. gauge. Quarter-elliptical spring suspension, back and front; brakes in rear wheels.

ENSIGN. British Ensign Motors, Ld., Hawthorne Road, Willesden, N.W.10.

Six-cylinder (102 × 140 mm.) 30 h.p. motor; valves overhead, aluminium jacketing. Electric starting and lighting outfit. Disc clutch, three forward speeds, live axle drive, wheelbase 12 ft. 4 in., 4 ft. 8½ in. track, 895 × 135 mm. wheels, cantilever rear suspension.

ERIC, CAMPBELL. Eric, Campbell & Co., 16, Gloucester Road, S.W.7.

Four-cylinder (66 × 109 mm.) 10 h.p. Coventry-Simplex bloc motor, with thermal water-cooling, chain-driven valve-shaft, Zenith carburetter, M.L. magneto, forced feed lubrication, and leather cone clutch. Three forward speeds (box by Chater-Lea) and bevel-geared live axle. Chater-Lea worm steering-gear, semi-elliptic suspension, Rubery Owen pressed steel frame, Rotax lighting outfit. All-aluminium body by Dalling & Co., wire 710 × 90 wheels, wheelbase 8 ft., gauge 3 ft. 10 in.

ESSEX (U.S.A.). Hudson and Essex Motor Co., 13, Park Place, S.W.1.

Four-cylinder (3⅜ in × 5 in.) 20 h.p. bloc engine, three-bearing crank-shaft, pump and trough lubrication, overhead valves, multi-disc oil lubricated clutch, three forward speeds, helical bevel-geared live axle, underslung semi-elliptic suspension, removable rims, two-unit Delco starting-lighting apparatus. Unit motor and gear-box.

F.A.S.T. (Italy). Isotta-Fraschini, 45, Crawford Place, Edgware Road, London, W.

Four-cylinder (84 × 135 mm.) monobloc motor, 20 h.p., overhead (double exhaust) valves, pump-fed oil and water circulation, five-bearing crank-shaft, multi-disc clutch, three-speed unit gear-box, bevel-geared live axle, single-jointed enclosed cardan shaft, rear hub brakes, semi-elliptic suspension.

FERGUS (Ireland). J. A. McKie, Belfast.

New model, with six-cylinder engine, to be constructed. No further details yet available.

FIAT (Italy). Fiat Motors. Ld., 1, Albemarle Street, W.1.

Four-cylinder (65 × 110 mm.) 12–16 h.p. moteur bloc, with removable crown. Fiat electric starting and lighting plant. Multi-disc clutch, four forward speeds, spiral bevel-gear live axle, semi-elliptical suspension. Fiat removable wheels. All brakes in back wheels. Pump-forced oiling and water cooling; improved carburetter. Wheelbase 8 ft. 11 in., track 4 ft. 2 in. Details of three other higher-powered models not yet available.

FORD (U.S.A.). Ford Motor Co., Detroit, Mich.

Four-cylinder 20 h.p. standardised chassis. No alterations notified.

G.N. G.N. Motor Co., Ld., Etna Works, Hendon, N.W.

Two-cylinder V-type air-cooled 8 h.p. engine, two forward speeds, shaft and chain drive, "coster-barrow" spring suspension; two-seated body, wire wheels.

GREGOIRE (France). Gregoire Automobiles, 74, East Hill, Wandsworth.

Four-cylinder (85 × 130 mm.) 17–50 h.p. monobloc motor, conical clutch, four forward speeds, brakes on back wheels, semi-elliptic suspension, electric starting-lighting apparatus, 815 × 105 mm. wire wheels, wheelbase 9 ft. 6 in., track 4 ft. 8 in. Forced water and oil circulation.

G.W.K. G.W.K., Ld., Maidenhead.

Four-cylinder (66 × 100 mm.) 10 h.p. monobloc, with removable crown. Friction disc and gear drive to Chenard-De Dion type jointed cardan shafts supported by stationary separate axle. Driving pinion gears and brakes in centre line of rear road wheels. Disc wheels, with removable 700 × 80 mm. rims; 8 ft. 10 in. wheelbase, 4 ft. track, quarter-elliptical suspension.

Hammond. W. T. Pritchard, 14 Clifford Street, W.1.

Four-cylinder (69 × 150 mm.) 11–22 h.p. bloc engine, single valve-shaft, new system of gear-pump lubrication at 20 lb. per square inch: Zenith carburetter; special plate clutch, four-speed gear-box, worm-driven live axle, adjustable rear cantilever spring suspension; five Michelin disc wheels.

Hampton. Hampton Engineering Co., Stroud.

Four-cylinder (63 × 120 mm.) 10 h.p. monobloc motor, conical clutch, three forward speeds, bevel-geared live axle, electric starting-lighting mechanism, ¾-elliptic rear suspension, 9 ft. wheelbase.

H.E. Herbert Engineering Co., Ld., Caversham, Reading.

Four-cylinder (69 × 120 mm.) 11 h.p. bloc engine, removable head and valve caps. C.A.V. electric starting and lighting outfit. Pump and splash lubrication. M.L. magneto chain driven. Steel and iron multi-disc clutch, four forward speeds changed by gate lever, and all shafts on ball and roller bearings. Live axle, with worm-drive gear above and easily removable; brakes in rear wheel hubs. Five removable 760 × 90 mm. steel artillery wheels, wheelbase 9 ft. 6 in., track 4 ft. 2 in.

H.F.G. C. Portass and Sons, Ld., Heeley, Sheffield.

Two-cylinder 10 h.p. horizontal opposed unjacketed engine, overhead valves. Pedal operated starting ap-

pliance; plate clutch and friction disc drive to bevel-geared live axle. Tubular frame, 700 × 80 mm. disc wheels, quarter-elliptic front and cantilever back suspension, wheelbase 8 ft. 10 in., 4 ft. track; two-seated body.

HILLMAN. Hillman Motor Co., Ld., Pinley, Coventry.

Four-cylinder (65 × 120 mm.) 11 h.p. engine *en bloc*, with improved valve-caps, horizontal Zenith carburetter, M.L. magneto, and single unit starting-lighting mechanism driven by encased gears. Thermal water-cooling, three-bearing crank-shaft, gear pump and trough lubrication of improved construction. Leather-faced conical clutch, three forward speeds, brakes in back hubs, double knuckle-joints to open cardan shaft, overhead worm-geared live axle, central gear-shift and brake levers. Semi-elliptic suspension, 700 × 85 mm. artillery wheels, wheelbase 8 ft. 6 in., 4 ft. gauge.

HORSTMANN. S. H. Horstmann & Co., Monmouth Place, Bath.

Four-cylinder (60 × 88 mm.) 8 h.p. monobloc motor, lateral valves operated by rocking levers. Plunger pump and trough lubrication, leather cone-pressed steel clutch, leather ring universal joint on cardan shaft, three forward speeds in box on rear bevel-driven live axle; special braking mechanism. Bevel steering gear, quarter-elliptic suspension, pedal starting device, wire 650 × 65 mm. wheels.

HUDSON (U.S.A.). Hudson and Essex Motor Co., 13, Park Place, S.W.1.

Six-cylinder (3½ in. × 5 in.) 30 h.p. monobloc engine, removable head, pump and dipper lubrication, multi-disc cork "insert" clutch, three forward speeds in unit gear-box, helical bevel live axle, back wheel brakes, 34 in. × 4½ in. wheels, removable rims, semi-elliptical

underhung rear suspension. Vacuum fuel feed, forced water cooling. Delco electrical apparatus.

HUMBER. Humber. Ld., Coventry.

Four-cylinder (65 × 120 mm.) 10 h.p. engine, four speeds bevel-geared live axle. Electric starting and lighting apparatus. Wheels 760 × 90 mm., wheelbase 8 ft. 9½ in., track 4 ft. 1½ in.

Four-cylinder (75 × 140 mm.) 15 h.p. motor, specification as in 10 h.p. chassis, but 815 × 105 mm. wheels, and wheelbase 9 ft. 6 in., with 4 ft. 9 in. track.

HUPMOBILE (U.S.A.). Whiting, Ld., Euston Road, N.W.1.

Four-cylinder (83 × 140 mm.) 15–18 h.p. bloc engine, special lubrication system, three forward speeds, bevel-geared live axle, semi-elliptical suspension, artillery wheels.

ISOTTA-FRASCHINI (Italy). Isotta Fraschini, 45, Crawford Place, London, W.

Eight-cylinder (85 × 130 mm.) vertical monobloc motor, 50 h.p., Ferodo-faced multi-disc clutch, three forward speeds, bevel-geared live axle, four-wheel brake system, electric tyre-inflator, automatic wheel-jack, electric starting-lighting apparatus, wire wheels.

ITALA (Italy). Watkins & Doncaster, Ld., 95, Great Portland Street, London, W.

Four-cylinder (80 × 130 mm.) 15 h.p. bloc motor, single valve-shaft, and cross-front shaft drive to water pump and magneto. Dynamo and motor for lighting and starting. Multi-disc clutch, four forward speeds, gear and brake levers on gear-box cover, bevel-gear live axle. Pressure-fed fuel supply. Extra long rear semi-elliptic springs.

IVERNIA.

Four-cylinder (3½ in. × 7¼ in.) 50 h.p. bloc engine, cone clutch, single-jointed enclosed cardan shaft, bevel-geared live axle, four rear wheel brakes, wire wheels,

semi-elliptic underhung suspension, wheelbase 12 ft. 0 in., gauge 4 ft. 8 in.

KING (U.S.A.). Salmons and Son, St. Martin's Lane, W.C.1.

Eight-cylinder 30 h.p. V engine, three forward speeds, bevel-geared live axle, cantilever rear suspension, wire wheels.

LAGONDA. Lagonda Motor Co., Ld., Staines, Middlesex.

Four-cylinder (66 × 77 mm.) 11 h.p. motor, with overhead inlet valve rocking levers, conical clutch, three forward speeds, quarter-elliptic rear and cross-front spring suspension, 700 × 80 mm. artillery detachable wheels.

LANCHESTER. Lanchester Motor Co., Ld., Birmingham.

Six-cylinder (4 in. × 5 in.) engine, three forward speeds, disc clutch, worm-driven live axle, cantilever rear springs, 895 × 135 mm. wire wheels, 12ft. 6in. wheelbase, 4 ft. 10 in. gauge.

LANCIA (Italy). W. L. Stewart & Co., Ld., 26b, Albemarle Street, W.1.

Four-cylinder (110 × 130 mm.) monobloc 35 h.p. engine, multi-disc clutch, four forward speeds, bevel-geared live axle, 835 × 135 mm. wire wheels, wheelbase 11 ft., track 4 ft. 5½ in. Electric starting-lighting equipment.

LAUNCESTON.

Four-cylinder 8 h.p. motor *en bloc*, three speeds, bevel-geared live axle, "coster-barrow" suspension, disc wheels.

LIBERTY (U.S.A.). Melchior, Armstrong and Dessau, Ld., 27, Maddox Street, W.1.

Six-cylinder (83 × 114 mm.) 25 h.p. bloc motor, with single-plate clutch, three forward speeds, and spiral bevel-geared live axle. Berling magneto; electric starting

and lighting outfit, semi-elliptic suspension, wheelbase 9 ft. 9 in.

L.S.D.

Two-cylinder 8 h.p. air-cooled V engine in front, two forward speeds, shaft-and-chain drive, three disc wheels, two-seated body.

MAIBOHM (U.S.A.). F. W. Southgate & Co., 19–21, Heddon Street. W.1.

Six-cylinder (78 × 108 mm.) 30 h.p. valve-in-head motor, thermal water circulation, H.T., magneto ignition, disc dry clutch, three forward speeds, electric starting and lighting equipment, semi-elliptic suspension, 32 in. × 4 in. removable wire or artillery wheels, wheelbase 9 ft. 8 in.

MARLBOROUGH (France). T. B. André & Co., London, W.1.

Four-cylinder (62 × 100 mm.) moteur bloc, three-bearing crank-shaft, Zenith carburetter, thermal water-cooling, multi-disc clutch, three forward speeds, steel artillery 700 × 85 mm. wheels, wheelbase 9 ft. 0 in., gauge 4 ft. 0 in.

MASCOTTE. Mascotte Engineering Co., Ltd., 237, Kensal Road, London, W.

Four-cylinder 10-h.p. Dorman engine, three forward speeds, worm-geared live axle, three-seated body. Leather cone clutch, Zenith carburetter, 700 × 80 mm. wire wheels, wheelbase 7 ft. 6 in., track 3 ft. 9 in.

MATHIS (France). V. Mathis, Strasbourg.

Four-cylinder (60 × 100 mm.) 10 h.p. monobloc engine, with disc clutch and four-speed gear-box a unit, central gear-shift lever, double-jointed cardan shaft, bevel-geared live axle, underslung semi-elliptic rear suspension.

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Maxwell (U.S.A.). Maxwell Motor Co., Great Portland Street, W.1.

Four-cylinder (92 × 114 mm.) 18 h.p. bloc motor, two-bearing crank-shaft, detachable head, Kingston carburetter, fabric cone clutch, three forward speeds, bevel-driven live axle, artillery 30 in × 3½ in. wheels, 9 ft. 1 in. wheelbase, 4 ft. 8 in. track, enclosed cardan shaft, semi-elliptic springs, brakes in wheel-hubs, plunger oil pump, single starting-lighting unit.

Mercury. Mercury Cars, Ld., Gould Road, Twickenham, Middlesex.

Four-cylinder (64 × 102 mm.) 10 h.p. bloc engine, thermal cooling, slipper expanding clutch, three forward speeds, live axle drive, rear cantilever suspension, wheelbase 9 ft. 0 in., gauge 4 ft. 0 in., 710 × 90 mm. wheels.

Merrall-Brown. Premier Engineering Co., Bolton.

Two-cylinder (85 × 96 mm.) 8 h.p. water-cooled V Precision engine, thermal circulation, Thomson-Bennett magneto, steel and Ferodo-faced disc clutch, shaft drive to two-speed gear-box, final transmission by exposed roller chain adjustable through radius rods, semi-elliptic front and coster-barrow back springs, rear pair of wheels close together, bobbin and double steel cable steering mechanism.

Metallurgique (Belgium). Metallurgique Cars Co., Edgware Road, Cricklewood.

Four-cylinder (80 × 130 mm.) 15 h.p. monobloc motor offset hollow crank-shaft, forced lubrication, thermal cooling leather-faced conical clutch, four forward speeds, Gleason helical bevel-geared live axle, wire wheels, Zenith carburetter, Westinghouse electric starting-lighting outfit.

Meteorite. Meteor Motors, Ltd., 142, Uxbridge Road, Shepherd's Bush.

Four-cylinder (66 × 110 mm.) 10 h.p. bloc motor, thermal cooling, Solex carburetter, leather cone clutch,

three forward speeds, bevel-geared live axle, three-quarter elliptic rear suspension, wheelbase 8 ft. 6 in., track 4 ft. 2 in., 700 × 85 mm. wheels.

MINERVA (Belgium). Minerva Motors, Ld., Chenies Street, W.C.

Four- and six-cylinder (90 × 140 mm.) double-sleeve valve engines. 20 and 30 h.p. respectively, vacuum fuel feed, conical clutch, four forward speeds, cantilever rear suspension, bevel-geared live axle, 880 × 120 mm. wire wheels, electric starting and lighting apparatus.

MITCHELL (U.S.A.). Wm. Bailey, 85 Great Portland Street, W.1.

Six-cylinder (83 × 127 mm.) 40 h.p. monobloc engine, detachable head. Thermostatic water circulation system, plunger oil pump, triple-disc dry clutch, three forward speeds operated by central lever, spiral bevel-geared live axle in banjo-type casing. Cantilever rear suspension, 34 in. × 4 in. wheels, with detachable rims. Electric starting-lighting outfit. Internal and external brakes to back hubs.

MOON (U.S.A.). North-Western Motor Co., Liverpool.

Six-cylinder (82 × 114 mm.) 20 h.p. Continental engine, Bosch magneto, dry plate clutch, three forward speeds, bevel gear, Timken live axle, internal and external brakes on rear wheels (33 in. × 4½ in. detachable wire). Delco motor starter: semi-elliptical suspension, wheelbase 9 ft. 10 in.

MORGAN. Morgan Motor Co., Malvern.

Two-cylinder M.A.G. air-cooled (or water-jacketed) 8 h.p. V engine, cone clutch, two speeds, shaft and chain drive, three 26 in × 2½ in. disc wheels, two-seated body, coil front and quarter-elliptic rear springs, wheelbase 7 ft. 0 in., track 3 ft. 9 in.

MORRIS. Morris Motors, Ld., Cowley, Oxford.

Four-cylinder (69 × 102 mm.) 11 h.p. White and Poppe monobloc motor, removable cylinder cover, W. and P. carburetter, pump lubrication, multi-disc clutch, three forward speeds, worm-driven live axle, 700 × 80 mm. (also 710 × 90 mm.) steel wheels, wheelbase 8 ft. 6 in., 4 ft. 0 in. track, ¾-elliptic rear suspension, electric starting and lighting.

MOTOBLOC (France).

Four-cylinder (80 × 120 mm.) 15 h p. engine, multi-disc clutch, four forward speeds, bevel-driven live axle, ¾-elliptic rear suspension, artillery wheels, electric lighting-starting outfit.

NAPIER. D. Napier and Son, Ld., Acton Vale, W.3.

Six-cylinder (102 × 127 mm.) 40–50 h.p. monobloc motor, one-plate and fabric-lined clutch, four forward speeds, central gate and brake levers, two S.U. carburetters, C.A.V. lighting and starting equipment, running band-shoe brake behind gear-box, helical-bevel live axle, 895 × 135 mm. wire wheels, cantilever rear suspension, wheelbase 11 ft. 5 in., gauge 4 ft. 8 in. Aluminium jackets and pistons, removable cylinder crown, valves and valve-shaft overhead, steel liner-barrels to the cylinders. Tubular connecting rods, seven-bearing crank-axle, centrifugal pump circulation, single-joint enclosed cardan shaft.

NEW ORLEANS.

Four-cylinder (76 × 165 mm.) 30 h.p. bloc motor, pump water-cooling and lubrication, hollow crank-shaft, leather cone clutch, special device for variable gear effect, single-joint enclosed cardan shaft, full floating helical bevel-driven live axle, all brakes in rear hubs, wire disc 880 × 120 mm. wheels, wheelbase 10 ft. 9 in., track 4 ft. 8 in., underslung semi-elliptic rear suspension, central

control and brake levers, electric starting and lighting equipment. Engine-operated tyre pump.

OLDSMOBILE (U.S.A.). General Motors, Ld., 136, Long Acre, W.C.

Eight-cylinder 40 h.p. V-type engine, disc clutch, three forward speeds, bevel-gear live axle, artillery wheels, removable rims, Delco starting and lighting outfit.

OVERLAND (U.S.A.). Willys-Overland, Ld., 153-5, Great Portland Street, London, W.

Four cylinder (83 × 127 mm.) 18 h.p. engine *en bloc*, conical clutch, three forward speeds, bevel-geared live axle, artillery wheels 765 × 105 mm. Electric starting-lighting set. Rear cantilever suspension, wheelbase 8 ft. 10 in., gauge 4 ft. 8 in.

PALLADIUM. Palladium Autocars, Ld., Felsham Road, Putney, S.W.

Two-cylinder (89 × 107 mm.) horizontal opposed air-cooled 10 h.p. engine, friction disc and drive to cross-shaft, quarter-elliptic suspension, 700 × 85 mm. disc wheels, wheelbase 8 ft. 6 in., track 4 ft. 6 in.

PANHARD-LEVASSOR (France). Panhard & Levassor, Acton Vale, London, W.

Four-cylinder (70 × 140 mm.) 12 h.p., 18 h.p. (85 × 140 mm.), 28 h.p. (105 × 140 mm.) engines, the two larger motors having double sleeve-valve motion. All chassis have disc and fibre clutches, four forward speeds and bevel-geared live axle drive, with semi-elliptic suspension.

12 h.p. chassis,	wheelbase	9 ft. 6 in.,	gauge 4 ft. 6½ in.
18 ,, ,,	,,	10 ft. 9 in.,	,, 4 ft. 8 in.
28 ,, ,,	,,	11 ft. 4 in.,	,, 4 ft. 8 in.

PEERLESS (U.S.A.). Gaston, Williams and Wigmore, Ld., 212, Great Portland Street, W.1.

Eight-cylinder (82 × 127 mm.) 40 h.p., 90° V-bloc engine, multi-disc dry clutch, double-jointed cardan

shaft, three forward speeds, spiral bevel-geared live axle, transverse inverted and semi-elliptic rear suspension, 34 in. × 5½in. wire wheels, removable rims, 10 ft. 5 in. wheelbase, 4 ft. 8 in. track. Unit gear-box system, offset valves, three-bearing crank-shaft, two carburetters, pumped water and oil circulation. Atwater-Kent electrical apparatus; back-wheel braking.

PEUGEOT (France). Peugeot (England), Ld., 10, Brompton Road, London, S.W.

Four-cylinder (68 × 100 mm.) 8 h.p. monobloc motor, with valves removable through caps and set at an angle. Three-bearing offset crank-shaft, plunger oil pump, Zenith carburetter, forced water circulation, double disc clutch, four forward speeds, enclosed cardan shaft, bevel-geared live axle. Special quarter-elliptic rear spring suspension, wire 710 × 90 mm. wheels, wheelbase 8 ft. 8 in., track 3 ft. 10 in. Universal joint in front of gear-box only.

Other Peugeot models for 1920: particulars not available.

PHŒNIX. Phœnix Motors, Ld., 111, Great Portland Street, W.1.

Four-cylinder (69 × 100 mm.) 11 h.p. monobloc engine, thermal water cooling, oil-immersed metal conical clutch, three forward speeds, worm-driven live axle, 750 × 85 mm. removable artillery wheels, wheelbase 8 ft. 0 in., gauge 4 ft. 2 in. Pressure-fed lubrication, adjustable steering column, clutch and brake-pedal levers.

PICCARD-PICTET (Switzerland and France). Donne & Willans (1909), Ld., 29A, Gillingham Street, London, S.W.

Four-cylinder 16 h.p. and 30 h.p. eight-cylinder V engines, monobloc type, 85 × 130 mm. Both chassis have engines with single-sleeve valve-motion, multi-disc clutch, four forward speeds, live axle drive, and semi-elliptic suspension, with cardan shaft and front and rear wheel brakes. Wire 880 × 120 mm. wheels, wheelbase

10 ft. 6 in (also 13 ft. 2 in.), gauge 4 ft. 6 in. Detachable cylinder crowns, pump cooling, vacuum petrol supply system.

RENAULT (France). Renault, Ld., Seagrave Road, West Brompton, S.W.

Four-cylinder engines: 14 h.p. (75 × 120 mm.); 20 h.p. (80 × 140 mm.): 25 h.p. (95 × 160 mm.); six-cylinder 40 h.p. (100 × 160 mm.). All chassis with conical clutch, four forward speeds, cardan shaft and bevel-driven live axle, and semi-elliptic suspension (underslung rear).

RICHARDSON. C. E. Richardson & Co., Ld., Sheffield.

Two-cylinder air-cooled 8 h.p. V-type J.A.P. engine in front, friction disc drive and single-chain transmission to live rear axle. three forward speeds and reversing motion. semi-elliptic suspension. 650 × 65 mm. wire wheels, wheelbase 6 ft. 6 in., gauge 3 ft. 9 in., fuselage type chassis.

ROAMER (U.S.A.). W. Cole and Sons. 235, Hammersmith Road, W.

Six-cylinder (89 × 133 mm.) 30 h.p. motor, disc dry clutch, three forward speeds, bevel-gear live axle, semi-elliptical spring suspension, wheelbase 10 ft. 8 in., track 4 ft. 6 in. Electric lighting-starting outfit; wire 32 in. × 4 in. wheels.

ROLLS-ROYCE. Rolls-Royce, Ld., Conduit Street, W.1.

Six-cylinder (114 × 120 mm.) 45 h.p. engine with triple-cast cylinders, conical clutch, four forward speeds, bevel-geared live axle, rear suspension cantilever.

ROVER. The Rover Co., Ld., Coventry.

Four-cylinder (75 × 130 mm.) 12 h.p. bloc motor, oil-immersed single-ring clutch, three forward speeds, live axle-worm drive, semi-elliptical suspension, wheels 810 × 90 mm. detachable, wheelbase 9 ft. 8 in., track

4 ft. 2 in. Lucas electric lighting and starting equipment. Cushioning mechanism between clutch and gears.

RUSTON-HORNSBY. Ruston and Hornsby, Ld., Lincoln.

Four-cylinder (80 × 130 mm.) monobloc engine, 15 h.p. removable heads; barrels cast with upper part of crank chamber. Gear oil pumping, H.T. magneto ignition, Zenith carburetter, forced water circulation. Leather cone clutch, three forward speeds, single-fabric cardan shaft joint, gear-box in one piece on back, bevel-geared axle. Central gear-shift lever. Three-quarter elliptic rear suspension, undershung, 4 ft. 6 in. in length, both brake sets in back, 815 × 105 mm. Michelin detachable disc wheels. C.A.V. dynamo lighting set and starting gear. Marles's steering gear.

SAXON (U.S.A.). L. C. Rawlence & Co., Ld., 10, Sackville Street, London, W.

Six-cylinder (73 × 114 mm.) monobloc Continental 20 h.p. motor, multi-disc clutch, three forward speeds, bevel-gear Timken live axle, roller bearings, cantilever rear suspension, wire wheels, wheelbase 9 ft. 4 in., electric starting-lighting plant.

SCHNEIDER (France). Donne & Willans (1909), Ld., 29A, Gillingham Street, Belgravia, London, S.W.

Four- and six-cylinder (80 × 140 mm.) 20 and 30 h.p. bloc engines, leather cone clutch, four forward speeds, bevel-driven live axle, 875 × 105 mm. wire or Sankey steel wheels. Double-jointed clutch arbor, single-jointed encased cardan shaft, rotary pump lubrication, thermal water-cooling through radiator in front of chassis.

SCRIPPS-BOOTH (U.S.A.). General Motors Expedit Co., 1761, Broadway, New York.

Four-cylinder (93 × 100 mm.) 20 h.p. valve in head motor, disc clutch, three forward speeds, wire wheels, semi-elliptic undershung suspension.

Six-cylinder 30 h.p. valve in head motor, rear cantilever suspension. Specification as for 20 h.p. type.

Eight-cylinder 35 h.p. V-type engine, rear cantilever suspension. Specification as for 20 h.p. type.

SECQUEVILLE-HOYAU (France.) Secqueville-Hoyau, Ld., Regent House, Regent Street, W.1.

Four-cylinder (60 × 110 mm.) 18 h.p. block inclined valve engine, three-bearing crank-shaft, disc clutch, four forward speeds, double-jointed open cardan shaft, bevel-geared live axle, Claudel carburetter, Weymann vacuum fuel feed, tubular connecting rods and cardan shaft, helical valve gearing, 710 × 90 mm. detachable wire wheels, underslung semi-elliptical suspension, 7 ft. 10 in. wheelbase. Electric starting and lighting set, Nilmelior magneto. Steel and Ferodo fabric disc universal joints.

SHEFFIELD-SIMPLEX. Sheffield-Simplex, Ld., Conduit Street, W.1.

Six-cylinder (89 × 127 mm.) triple-cast 30 h.p. motor, multi-disc clutch, four forward speeds, underhung worm-driven live axle, forced lubrication, pump water-cooling. Cantilever rear suspension, 935 × 135 mm. wire wheels, wheelbase 12 ft. 0 in., 4 ft. 8½ in. track. Electrical starting-lighting apparatus.

SIGMA (France). Gaston, Williams and Wigmore, Ld., 212, Great Portland Street, W.1.

Four-cylinder (65 × 120 mm.) monobloc 12 h.p. engine, four-speed gear-box a unit with motor, multi-disc oil lubricated clutch, cardan and rear hub brakes, semi-elliptical suspension, Michelin disc wheels, electric starting-lighting apparatus.

SINGER. Singer Motor Co., Ld., Coventry.

Four-cylinder (63 × 88 mm.) 10 h.p. engine, leather cone, clutch, three forward speeds, gear-box on bevel-driven live axle, autmoatic lubrication, thermal water-cooling, Claudel carburetter, 700 × 80 mm. steel artillery detachable wheels, wheelbase 7 ft. 6 in., gauge 3 ft. 6 in.

SIZAIRE BERWICK. F. W. Berwick & Co., Ld., Park Royal, N.W.

Four-cylinder (95 × 160 mm.) bloc engine, 25 h.p., cone clutch, four forward speeds, spiral bevel-gear live axle, running-brake behind gear-box, double-jointed cardan shaft. Semi-elliptical underslung suspension, wheels 895 × 135 mm. wire disc, wheelbase 11 ft. 9 in., track 4 ft. 8 in. Pump lubrication, combination pump and thermal water-cooling, Zenith carburetter, electric starting-lighting mechanism.

S.P.A. (Italy). Vandys, Ld., 27a, Pembridge Villas, W.11.

Four-cylinder (110 × 160 mm.) bloc engine, 35–50 h.p., multi-disc clutch, four forward speeds, single-jointed cardan shaft enclosed by tapered tubular cover to live axle (bevel-geared) casing.

Four-cylinder (110 × 140 mm.) bloc engine, 25–30 h.p., chassis details as in 35–50 h.p. model.

SPEEDY. Pullinger Engineering Co., 52, Holborn Viaduct, E.C.1.

Two-cylinder J.A.P. 8 h.p. air-cooled V engine, leather cone clutch, two chain drives between motor, two-speed gear-box and cross-shaft, thence by double V-belts to pulleys on rear wire, 650 × 65 mm. disc wheels, 5 ft. 6 in. × 4 in. × 1¾ in. ash-wood frame. Coster-barrow type suspension, direct (hand-wheel) steering gear, electric lighting set, two-seated flush-side body with wind-screen. Chiefly noticeable as probably, for the present, the cheapest "motor-car" on the market, the price being £115 10s.

SPYKER (Holland). Motorenfabriek Spyker, Trompenburg.

Four-cylinder (90 × 140 mm.) 15–30 h.p. engine, multi-disc clutch, four forward speeds, bevel-geared live axle,

835 × 135 wire wheels, wheelbase 10 ft. 11 in., gauge 4 ft. 8 in.

STAFFORD. Stafford Associated Engineering Co., Battersea, S.W.

Four-cylinder (69 × 120 mm.) 12 h.p. Dorman valve-in-head engine, Ferodo-faced cone clutch, three forward speeds, three leather knuckle-joints, bevel-geared live axle, double expansion brakes in rear hubs, ¾-elliptic rear suspension, five 760 × 90 mm. Sankey detachable steel artillery wheels, four-seated body.

STANDARD. Standard Motor Co., Ld., 49, Pall Mall, S.W.1.

Four-cylinder (62 × 110 mm.) 9 h.p. monobloc motor, one-plate clutch, three forward speeds, worm-geared live axle, semi-elliptic suspension, 700 × 80 mm. steel artillery wheels, wheelbase 7 ft. 8½ in., gauge 4 ft. 0 in., electric starting-lighting apparatus, Zenith carburetter, pump lubrication, thermal water circulation.

STAR. Star Motor Co., Ld., Long Acre, W.C.

Four-cylinder 15 h.p. and 20 h.p. motors, cone clutch, four forward speeds, bevel-geared live axle. Other features common to both chassis are: Pressure-fed lubrication, water-cooling by pump, removable artillery steel wheels, wheelbase 10 ft. 3½ in., electric engine-starting and car-lighting equipment.

STELLITE. Electric Ordnance and Accessories Co., Ld., Birmingham.

Four-cylinder (62 × 89 mm.) bloc 9 h.p. engine, leather cone clutch, two forward speeds, underhung worm-driven live axle, 700 × 80 mm. steel artillery wheels, wheelbase 8 ft. 3 in., track 3 ft. 10 in. Pressure-fed lubrication, thermal water circulation, S.U. carburetter.

STOREY. Storey Machine Tool Co., New Cross, S.E.

Four-cylinder (76 × 120 mm.) 14 h.p. monobloc Coventry-Simplex engine, "impeller" type thermal water-cooling, Ferodo-lined cone clutch, three forward speeds by gearbox on worm-driven back axle. Rotax electrical equipment, wheels 815 × 105 mm. horizontal Zenith carburetter, pressure-fed lubrication, wheelbase 9 ft. 9 in., track 4 ft. 6½ in.

STRAKER-SQUIRE. Straker Squire, Ld., Angel Road, Edmonton, N.

Six-cylinder (80 × 130 mm.) 20 h.p. two-block vertical overhead-valve engine, single-disc clutch, four forward speeds, bevel-geared live axle, rear cantilever suspension, wire wheels, wheelbase 10 ft. 6 in., gauge 4 ft. 7½ in. Electric starting and lighting equipment.

STUDEBAKER (U.S.A.). Studebaker, Ld., Great Portland Street, W.1.

Six-cylinder (3⅞ × 5 in.) monobloc engine, removable crown, aluminium leather-faced cone clutch, three forward speeds, spiral-bevel live axle, semi-elliptic suspension, running band brake, expanding shoe brakes in rear hubs, artillery wheels, with 33 in. × 1½ in. removable rims, wheelbase 10 ft. 6 in., pump and splash lubrication, centrifugal water-cooling pump, electric lighting outfit.

SUNBEAM. J. Keele, Ld., 72, New Bond Street, W.1.

Four-cylinder 16 h.p. bloc and six-cylinder 24 h.p. motors (80 × 150 mm.), fabric-faced conical clutch, four forward speeds, bevel-geared live axle, semi-elliptical underslung rear suspension, steel artillery 820 × 120 mm. wheels. Wheelbase and track—16 h.p. car, 10 ft. 6 in. × 4 ft. 6 in.; 24 h.p. car, 11 ft. 4¾ in. × 4 ft. 6 in. Pump water-cooling and lubrication.

Two "sporting" six-cylinder chassis also made—viz. a

Tourist-Trophy model and a machine, with air-craft-type engine.

SWIFT. Swift of Coventry, Ld., Coventry.

Four-cylinder (69 × 130 mm.) bloc engine, 12 h.p., encased angular-set chain-driven valves, conical leather-lined clutch, four forward speeds, bevel-geared live axle, semi-elliptical suspension, 760 × 90 mm. removable steel wheels, wheelbase 9 ft. 0 in., track 4 ft. 0 in., magneto chain drive, electric starting-lighting equipment, thermal water circulation, pump lubrication.

TEMPLAR (U.S.A.). Melchior, Armstrong and Dessau, Ld., 27, Maddox Street, W.1.

Four-cylinder (86 × 130 mm.) 18 h.p. monobloc motor, overhead valve-motion, removable crown, dry plate clutch, three forward speeds, bevel-geared live axle, semi-elliptical suspension, removable wire wheels, Zenith carburetter, water temperature indicator, double-jointed open cardan shaft, barrel-type back axle case, brakes in rear wheels, engine and gears a unit, vacuum fuel feed, electric starting-lighting outfit.

THOR. Simpson Taylor, Ld., 12 Palace Street, S.W.1.

Four-cylinder (79 × 114 mm.) 15 h.p. monobloc motor, detachable heads, cylinders cast with upper part of crank-case, dry-disc clutch, engine a unit with three-speed gear, semi-elliptic front, cantilever rear suspension, 760 × 90 mm. artillery wheels with removable rims, wheelbase 9 ft. 6 in., track 4 ft. 8 in., Allis-Chalmers single-unit electric starting-lighting set, Schebler carburetter, cast-iron gear-box, bevel live axle, plunger pump oiling, thermal water circulation, central gear-shift lever, brakes in back wheels.

VARLEY-WOODS. H. S. Tool Co., Ld., Shaftesbury Road, Acton.

Four-cylinder 12 h.p. Dorman engine (69 × 120 mm.), overhead valves, inverted cone clutch, four forward

speeds, overhead worm-driven live axle, rear cantilever suspension with two overhead torque and radius rods, Sankey 815 × 105 mm. wheels, 10 ft. 6 in. wheelbase, gauge 4 ft. 1 in., electric starting-lighting equipment.

VAUXHALL. Vauxhall Motors, Ld., Luton, Beds.

Four-cylinder (95 × 140 mm.) 25 h.p. and 30 h.p. (98 × 150 mm.) bloc engines, multi-disc graphite lubricated clutch, five-bearing crank-shaft, four forward speeds, helical bevel-geared live axle, plunger pump lubrication, forced water circulation, pressure-fed fuel supply, 880 × 120 mm. wire wheels, 9 ft. 6 in. and 10 ft. 10 in. wheelbase.

VERMOREL (France). W. G. James, 14, Mortimer Street, W.1.

Four-cylinder (70 × 130 mm.) 12 h.p. bloc motor, leather-faced inverted conical clutch, four forward speeds, engine and gear-box a unit, central gear-shift and brake levers, brakes behind gear-box and in rear hubs, double-jointed open cardan shaft, bevel-geared live axle, combination rear cantilever and quarter-elliptical suspension of exceptional length, thermal water circulation, plunger oil pump, offset crank-shaft, steel artillery wheels, wheelbase 9 ft. 0 in., track 4 ft. 0 in.

VULCAN. Vulcan Motor and Engineering Co., Ld., Southport, Lancs.

Four-cylinder (80 × 130 mm.) 15 h.p. bloc engine, cone clutch, four forward speeds, worm-driven axle, semi-elliptic suspension, wheelbase 10 ft. 0 in., track 4 ft. 8 in., 815 × 105 mm. wheels.

Eight-cylinder (70 × 114 mm.) 20 h.p. V-motor, with chassis of 10 ft. 4 in. wheelbase, electric starting and lighting outfit, 820 × 120 mm. wheels.

WAVERLEY. Waverley Cars, Ld., Trenmar Gardens, Harrow Road, Willesden.

Four-cylinder (76 × 127 mm.) bloc 15 h.p. motor, conical clutch, three forward speeds, bevel-geared live

axle, wheelbase 10 ft. 0 in., track 4 ft. 4 in., wheels 810 × 90 mm., electric starting-lighting apparatus.

WESTCOTT (U.S.A.). H. C. Motor Co., Great Portland Street, W.1.

Six-cylinder (89 × 133 mm.) 30 h.p. bloc motor, multi-disc clutch, three forward speeds, bevel-geared live axle, cantilever rear suspension, wheelbase 10 ft. 5 in., 33 in. × 4 in. artillery wheels.

WILTON. Wilton Cars, Ld., 120, High Street, Tooting, S.W.17.

Four-cylinder (66 × 100 mm.) 12 h.p. monobloc engine, Ferodo-lined disc clutch, three forward speeds, bevel-gear live axle, Zenith carburetter, pump lubrication, thermal water-cooling, steel artillery 700 × 80 mm. wheels, wheelbase 9 ft. 0 in., track 4 ft. 0 in.

WOLSELEY. Wolseley Motors, Ld., Adderley Park, Birmingham.

Four-cylinder (90 × 120 mm.) 16–20 h.p., six-cylinder (90 × 130 mm.) 24–30 h.p., and six-cylinder (102 × 140 mm.) 30–40 h.p. engines. Characteristics common to the three chassis are : multi-disc clutch, four forward speeds, electric starting and lighting, pair-cast engine cylinders, pump water-cooling, forced lubrication, detachable wire or steel artillery wheels. Worm-geared live axle in the 16–20 h.p. model, bevel-driven axles in the six-cylinder chassis. Wolseley special rear cantilever spring suspension system.

WOOLER. Wooler Motor Co., Ld., Alperton, Middlesex.

Two-cylinder 8 h.p. air-cooled opposed horizontal engine in front, chain and shaft drive, special pressed steel frame and helical-spring suspension, three-disc wheels, two-seated body.

ZEPHYR. James, Talbot and Davison, Ld., Lowestoft.

Four-cylinder (69 × 130 mm.) 12 h.p. bloc engine, removable crown, side-rod and lever overhead valve motion, thermal water-cooling, rotary oil pump Zenith carburetter, Férodo-faced conical clutch, four forward speeds in gear-box united with motor crank-pit, central gear-shift lever, single-jointed enclosed cardan shaft, worm-geared live axle, rear cantilever suspension, disc 760 × 90 mm. wheels, wheelbase 9 ft. 6 in., gauge 4 ft. 2 in., offset two-bearing crank-shaft, babbitted and roller bearings.

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